FOURTH NATIONAL COMMUNICATION TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

First National Communication in the context of the Kyoto Protocol

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Directorate-General for European Community Affairs
Directorate-General for Multilateral Affairs
Directorate-General for the Enterprise
Directorate-General for Geology and Energy
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Faculty of Sciences of the University of Lisbon
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International Relations Office of the Ministry of the Environment, Spatial Planning and Regional Development
Office of the Secretary of State for Internal Administration
Meteorology Institute
National Civil Aviation Institute
National Statistics Institute
Port and Sea Transport Institute
Portuguese Institute for Development Support
Institute for Waste Management

Preface

The United Nations Framework Convention on Climate Change, and especially the Kyoto Protocol, is perhaps one of the most operational instruments available to signatory countries for pursuing a more sustainable development path. This Fourth National Communication to the Convention is a relevant compilation of detailed information on Portugal's commitments to tackle global climate change.

This document, as well as the Demonstrable Progress Report already submitted, is a clear demonstration of the effort undertaken in recent years by the various and diversified sectors in Portugal, to rise to the challenge posed by one of the most concerning global environmental problem – climate change – and to honour Portugal's international commitments.

This has been a multi-faceted effort, which has resulted in an improved understanding of the national situation regarding emissions, a better perception of related causes and effects, as well as the development of means of dealing with the problem, both in terms of mitigation and adaptation.

Various steps have been undertaken, most recently the preparation of a new and more robust National Climate Change Programme (PNAC 2006); the choice of three of the four facultative sinks, namely forest management, cropland management and grazing land management; a significant improvement in inventories; the National Allocation Plan for 2008-2012, the establishment of the Portuguese Carbon Fund, and the appointment of the Climate Change Commission as Designated National Authority for the flexibility mechanisms foreseen in the Kyoto Protocol. More than simply satisfying commitments, More than simply satisfying commitments, the momentum in this field has "decarbonisation" of the economy as a principal objective, with benefits in efficiency, innovation and competitiveness.

Portugal's task in meeting Kyoto commitments is a demanding one, but it also presents opportunities. Although *per capita* carbon emissions are among the lowest in the European Union, the carbon intensity of Portugal's economy is far from being as low as it should be. There is, as such, an opportunity for gains in efficiency, for enhancing sustainability and, perhaps, to gain some strategic advantage during the first commitment period of the Kyoto Protocol and in a post-2012 scenario.

This document is yet another opportunity to better understand the recent Portuguese context in relation to climate change, and steps taken to effectively decrease emissions. The true carbon economy and society must involve all sectors, not just enterprise or government. Our climatic future, as well as our ability to comply with national and European commitments, is played out by our day-to-day choices, at our work places, at home, when shopping or through our transport and mobility. We do, effectively, control Climate Change.

H.E. the Secretary of State for Environment Humberto Rosa

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Executive Summary

The Fourth National Communication to the United Nations Framework Convention on Climate Change (First National Communication in the context of the Kyoto Protocol) hereby presented is organised in eight chapters describing the national circumstances, the national greenhouse gas (GHG) inventory, the impacts, vulnerability and adaptation, financial commitments and technology transfer, systematic research and observation, and education, training and awareness raising activities in accordance with articles 4 and 12 of the Convention, as well as the guidelines adopted in its 5th session (Decision 4/CP.5). Following the entry into force of the Kyoto Protocol in 2005, further information is also hereby submitted, under article 7(2) of the Kyoto Protocol.

The National Communication was prepared simultaneously with the Report for demonstration of progress until 2005 (under article 3(2) of the Kyoto Protocol). The main differences between the two documents are mainly in the level of detail: the National Communication provides a more in-depth coverage of all the aspects related to the Convention and the Protocol.

The objective was to have a document containing information covering the 1990-2004 period, coherent with the National Inventory Emissions by Sources and Removals by Sinks of GHG hereby presented, and previously submitted to the Convention (2006).

Portugal is bound by GHG limitation commitments, agreed in the context of the Kyoto Protocol and the European Union Burden Sharing Agreement[1], to a 27% increase in GHG emissions by 2008-2012, relative to 1990. The main instruments geared towards compliance with the national GHG emissions target and, more broadly, the implementation of the Kyoto Protocol include the National Climate Change Programme[2] (PNAC), the Monitoring and Assessment Programme of PNAC[3] (PNACm), the National System for the Estimation of Emissions by Sources and Removals by Sinks of Air Pollutants [4] (SNIERPA), the participation in the EU-ETS as defined by the National Allocation Plan[5] (PNALE) and the Portuguese Carbon Fund[6].

National Circumstances

Portugal comprises three territorial areas: the mainland, within the European continent, and the archipelagos of the Azores and Madeira (92 151.8 km^2). In 2004, there were 10 529 255 inhabitants in Portugal, which corresponds to an average population density of 114 inhabitants per km^2.

The factors that most influence the weather conditions in mainland Portugal are latitude, topographic relief, the influence of the Atlantic Ocean and its continentality. Although these factors show limited variation, there is still a significant differences in the meteorological parameters, namely in air temperature and precipitation. The mean temperature has risen in all of Portugal's regions since the 1970s, at a rate of approximately 0.15 ºC/decade,

[1] Decision 2002/358/CE of the Council, of 25 April 2002, on the approval, on behalf of the European Community, the Kyoto Protocol to the United Nations Framework Convention on Climate Change, and the joint compliance of their commitments. OJ L 130, of 15 May, pp. 1–20. Under this decision, the Member-States are jointly responsible for European Union's compliance with its quantified reduction objective. In this context, Portugal should not exceed, in the 5 year compliance period, its Assigned Amount (AA) of 385 970.45 kt CO_2e.

[2] Approved by Council of Ministers Resolution 119/2004 of 31 July.

[3] Council of Ministers Resolution 59/2005, of 8 July.

[4] Council of Ministers Resolution 68/2005, of 17 March.

[5] Council of Ministers Resolution 53/2005, of 3 March.

[6] Decree-Law 71/2006, of 24 March.

with 1997 being the warmest of the last 75 years. A similar trend was observed with temperature maximums and minimums and the frequency of heat waves. With regard to precipitation, the last 2 decades of the 20th century were particularly dry in mainland Portugal as opposed to the average values registered between 1961 and 1990. In fact, only in 6 of the last 20 years of the past century was the annual precipitation higher than the average. The driest of the past 75 years was 2005, and 2004 was the second driest on record.

With respect to the main economic indicators, Portugal experienced in the 1990s a sustained period of GDP growth that peaked at 4.8% (1998), followed by a deceleration over the last years into negative territory and back up to 0.3% in 2004. The Gross Value Added (GVA) of Portuguese industry has been decreasing (from 22.5% in 1995 to 18.7% in 2003), thus reflecting a deindustrialization process. A similar downward trend has also been recorded in the agriculture and animal production sectors (5.7% of GVA in 1995 to 3.4% in 2003). In contrast, the services sector has been expanding, with a contribution to the GVA growing from 65.9% in 1995 to 71.2% in 2003.

From 1990 to 2004, primary energy consumption grew at an annual rate of about 3%. In 2004, Portugal registered per capita consumption of 2.51 toe, contrasting with the 1990 value of 1.78 toe per capita. Crude oil consumption increased at a rate similar to that of total consumption. Currently, about 95.4% of primary energy consumed in Portugal is imported; in 2004, net energy imports represented almost 9% of the total entries of FOB[7] goods. On average, during the time frame considered, 84% of primary energy consumed was produced from fossil fuels (coal, crude oil, natural gas); renewable energy sources (domestic) represent the remaining 16%. Given the strong oscillations in hydroelectric production, the gross RES contribution to primary energy consumption is highly irregular.

The average annual contribution by RES to electricity generation was of 32% in the period from 1997 to 2004. Corrected by the hydraulic index on a yearly basis, and considering an average rainfall regime scenario, the annual average contribution by RES to overall electricity generation is of 36% for the same period.

Final energy consumption increased significantly (2.5% per year) from 1999 to 2004 mainly owing to the increase in consumption of crude oil products (1.7% oil; 24% natural gas) and of electricity (4.3% a year), as well as from the Transport and Services sub-sectors. Trends observed in energy consumption sub-sectors (Figure 13) show changes in demand. The Industry sub-sector, which represented 33% of consumption in 1990, was responsible for 30% of the final energy consumption in 2004. Conversely, the transport sub-sector represented in 2004 38% of the final energy consumption, while only 31% in 1990. Mobile sources, mainly road transport, are among the categories with fastest growth in final energy consumption. In 2004, the Residential and Service sub-sectors represented about 29% of total final energy consumption; Service sub-sector consumption grew 193% relative to 1990.

Energy intensity is an indicator of the efficiency and sustainability of the economy: in 2004, the energy intensity recorded for primary energy consumption was 214.4 toe/GDP; for final energy consumption, the value was 159.8 toe/GDP. This represents an increase, relative to 2003, of 1.5% and 1.0%, respectively.

As for passenger **transport**, the annual average variation in road transport from 1990 to 2004 surpassed that of other means, at almost 10%, as opposed to 6.6% for air transport and -2.1% for railway transport. The transport of goods is overwhelmingly done by road transport (domestic transport, with an annual rate of growth of 5% since 1990), over railway (3.6% annual growth over the same period).

On the **agriculture** front, the utilized agricultural area (UAA) has experienced small interannual variations, thus remaining mostly constant over the last decade. The crops with most significant agricultural production are cereals (excluding rice), potato and industrial crops. Rice production was at its lowest in 1993, then increased until 1996, from which point it decreased once again. Livestock production has been steady for the various breeds except pig, which reached a peak in 2004 (approximately 4.8 million heads).

[1] FOB (Free on Board) Price: charges collected in the location of loading.

In 2000, 72% of mainland Portugal was covered by forest and agriculture and 14% by mixed areas of agriculture and natural areas. The artificial territories covered only 3% of the mainland, and natural vegetation 9%. Among the artificial territories, discontinuous urban occupation is dominant, occupying approximately 70% of the area of each class. Industry, commerce and infrastructures are the second most significant occupation (12%), followed by built up areas (6%) and mines and quarries (6%). Within the 6 occupational classes assessed, between 1985 and 2000, the total area land cover change in mainland Portugal was of 371 000 hectares, which corresponds to 4% of the country.

According to the third revision of the 1995 National Forest Inventory (IFN), conducted in 1998, mainland Portugal had a forested area of 3.3 million hectares in 1995, corresponding to more than 37% of the overall land cover. According to the most recent IFN, almost 9 million m^3 of wood are taken from the forest annually, as well as 3 million m^3 of softwoods and 6 million m^3 of hardwoods. Cork plantations produce an average of 120 000 tonnes of cork. Forestry resources play an important role in the national economy. Forestry is mainly an export sector, with a net commercial balance exceeding 1 thousand million Euros in 2003. Forest products (softwood items, timber, cork oak, pulp, paper and wooden furniture) represent approximately 10% of the total Portuguese exports, and worth over 2.7 thousand million Euros with 5 million tonnes of product in 2004. Portuguese forests have undergone significant changes in the past decade, both as a result of the abandonment of agriculture and the consequent land use by forestry, as well as forest fires that have reached huge proportions and led to the declaring of a state of emergency within some regions of the country.

The production of Municipal Solid Waste (MSW) in mainland Portugal increased, in 2004, to 4.4 million tonnes, i.e. about 1.2 kg per inhabitant per day. All of the population is served by waste collection systems and the whole country is covered by inter/multi-municipal treatment and recovery systems. About 13 million tonnes of Industrial Waste (IW) was produced in 2002, of which 187 000 tonnes, approximately 1.4%, were labelled as Hazardous Industrial Waste (HIW). In 2004, the main incineration stations produced 477 180 MWh of energy (Lipor) and 48 176 MWh (Valorsul).

The National Greenhouse Gas Emission Inventory

The SNIERPA (Portuguese National System for the Estimation of Emissions by Sources and Removals by Sinks of Air Pollutants) compiles a number of institutional and legal definitions as well as procedures that aim to guarantee an estimate of the emissions, by sources and removals by sinks of air pollutants, the communication and the recording of relevant data to permit a timely formulation of the assessment of air pollutants according to defined international and community guidelines in order to enforce planning of tasks and management of the inventory taking into account cost-efficiency aspects. SNIERPA is made up of three technical bodies: the PDM (Methodological Development Programme), QA/QC (Quality Assurance and Control System) and SIGA (Integrated IT management system of SNIERPA). PDM and SCGQ guarantee precision, completeness and reliability in the inventory in terms of technical expertise and methodology.

In 2004, total GHG emissions estimates, without Land Use, Land Use Change and Forestry (LULUCF), accounted for 84.6 Mt CO_2e, an increase of approximately 41% relative to 1990. Emissions increased at about 3% per annum throughout the period 1990-2004.

The most significant source of GHG in Portugal is associated to the Energy sector and is directly related to the burning of fossil fuels. With 77% of the total 2004 emissions weighed by GWP[8], CO_2 is the most abundantly emitted GHG, 89.6% of which accrues to the energy sector.

[8] Global Warming Potential.

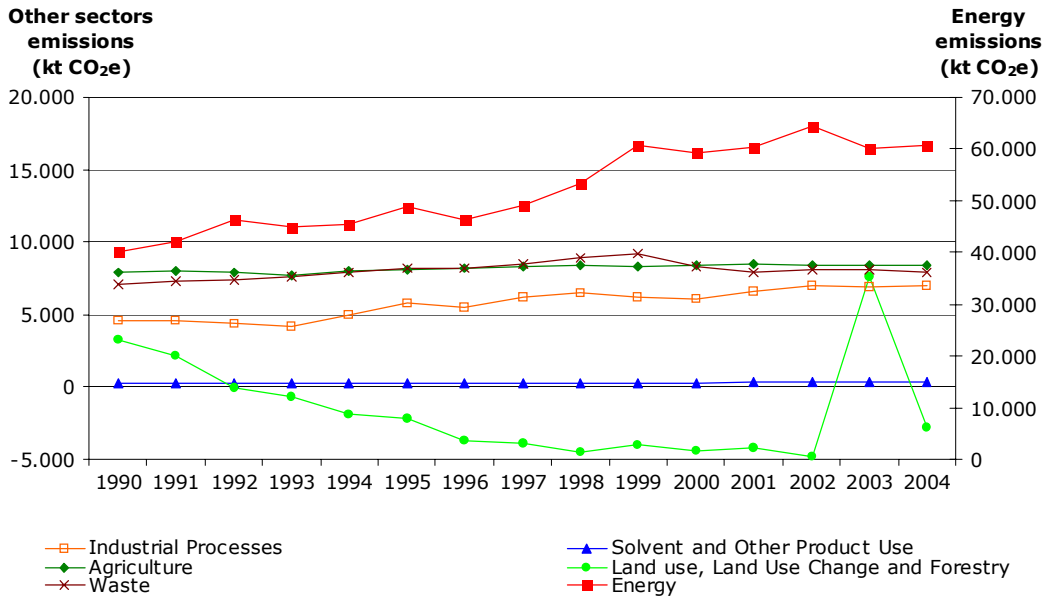

Figure 1. GHG Emissions and Removals (1990–2004)

Source: IAb, 2006

The energy sector is responsible for the most significant share of emissions, representing about 72% of the emissions total in 2004, a 51% increase from 1990. Within this sector, the Energy Supply and Transports sub-sectors are the most relevant, accounting for 25% and 24%, respectively, of the total national emissions in 2004. Portugal's dependency on fossil fuels is still increasing due to growth in electricity demand by the Residential and Services sub-sector as well as to increased mobility needs, such that total final energy consumption has increased by about 58% between 1990 and 2003. Emissions from the Transport sub-sector increased about 99%, in the period from 1990 to 2004, while those from the Industry and Construction sub-sectors have increased at the relatively lower rate of 17% in the same period. The Residential and Services sub-sector also recorded a significant increase: 59% relative to 1990. The emissions from Agriculture, Waste and industrial Processes sectors represented in 2004 about 10%, 12% and 8%, respectively, of the national emissions (excluding the LULUCF sector).

The key drivers explaining the increase in national emissions for this period are, among others, economic growth and increase in energy demand, traffic volume and distances covered by road transport. Weather parameters, such as precipitation, which have a high inter-annual variability, also have a significant influence on hydroelectric power production, thus influencing in a very significant manner the fluctuations in emissions. Portugal registered rapid economic growth in the 1990s, with GDP increasing by 38.6% between 1990 and 2004, an annual variation of 2.8%.

Throughout this period, Portugal did not manage to decouple growth in emissions from economic growth. However, there was a slight decrease in carbon intensity in recent years, a fact that may be explained by the implementation of some policies and measures with positive effects on GHG emissions such as the introduction of natural gas (1997), the introduction of combined cycle gas thermal electric plants, the progressive installation of co-generation units, energy and technology efficiency improvements in industrial processes and improvements in fuel quality. However, energy intensity is still growing moderately, reflecting sustained growth in the Transport as well as Residential and Services sub-sectors, the latter registering an increase in electricity demand.

Policies and Measures

The National Climate Change Programme (PNAC) is the main strategic instrument for compliance with GHG limitation commitments in the context of the Kyoto Protocol and the European Union Burden Sharing Agreement. The proposed policies and measures are broken down into those included in the Reference Scenario (MR) (implemented or adopted by the 1st January 2005), and the additional measures (MA), defined at a latter stage for ensuring that the GHG reduction targets are duly met. Table 1 summarises the proposed policies and measures and their respective reduction potential, by sector.

Table 1. Designation, affected gas and impact of measures on emissions reduction in 2010 (reference scenario and with additional measures scenario)

Policies and Measures	GHG	Emission reduction potential (kt CO2e) by 2010
Energy		
MRe1. "E4, E-FER" Programme	CO_2, CH_4, N_2O	280
MRe2. Energy Efficiency in Buildings	CO_2, CH_4, N_2O	90
MRe3. Solar Hot Water for Portugal Programme (AQSpP)	CO_2, CH_4, N_2O	101
MAe1. Energy efficiency improvement in the electricity generation sector	CO_2, CH_4, N_2O	146
MAe2. Energy efficiency improvement in the energy supply systems, considering electricity generation from co-generation	CO_2, CH_4, N_2O	200
MAe3. Improvement in energy efficiency from the electricity demand-side	CO_2, CH_4, N_2O	795
MAe4. Promotion of electricity produced from renewable energy sources	CO_2, CH_4, N_2O	855
MAe5. Introduction of natural gas in the Autonomous Region of Madeira	CO_2, CH_4, N_2O	5
MAr1. Realignment of the tax burden on diesel fuel for heating (residential sub-sector)	CO_2, CH_4, N_2O	14
MAs1 Realignment of the tax burden on diesel fuel for heating (services sub-sector)	CO_2, CH_4, N_2O	59
MAi1: Increase in tax on industrial fuels	CO_2, CH_4, N_2O	78
MAi2: Review of the Regulation on the Management of Energy Consumption (RGCE)	CO_2, CH_4, N_2O	32
MAi3: Incentives to the substitution of fuel oil co-generation by natural gas generation	CO_2, CH_4, N_2O	189
Transport		
MRt1. Auto-Oil Programme – Voluntary agreement with the car manufacturing associations (ACEA, JAMA, KAMA)	CO_2, CH_4, N_2O	175
MRt2. Expansion of the Lisbon Metro (ML)- extension of the Blue Line; extension of the Yellow Line; Red Line	CO_2, CH_4, N_2O	15
MRt3. Construction of the South of the Tagus River Metro (MST)	CO_2, CH_4, N_2O	13
MRt4. Construction of the Oporto Metro (MP)	CO_2, CH_4, N_2O	30
MRt5. Construction of the Mondego Light Metro (MLM)	CO_2, CH_4, N_2O	NA
MRt6. Supply changes (reduction in travel time) between Lisbon-Oporto; Lisbon-Castelo Branco; Lisbon-Algarve	CO_2, CH_4, N_2O	78
MRt7. Enlargement of the fleet of vehicles powered by natural gas of CARRIS and of the STCP	CO_2, CH_4, N_2O	1
MRt8. Incentive Programme for the dismantling of End-of-Life Vehicles	CO_2, CH_4, N_2O	3
MRt9. Reduction of motorway speeds	CO_2, CH_4, N_2O	0.6
MRt10. Biofuels Directive	CO_2, CH_4, N_2O	1243
MAt1. Reduction of Taxis´ service days	CO_2, CH_4, N_2O	4
MAt2. Enlargement of the fleet of taxi vehicles powered by natural gas	CO_2, CH_4, N_2O	0.2
MAt3. Review of the current tax regime on private vehicles	CO_2, CH_4, N_2O	8
MAt4. Metropolitan Authority of Lisbon Transports	CO_2, CH_4, N_2O	245
MAt5. Metropolitan Authority of Oporto Transports	CO_2, CH_4, N_2O	101

Policies and Measures	GHG	Emission reduction potential (kt CO2e) by 2010
MAt6. Incentive Programme for the dismantling of End-of-Life Vehicles (further objectives)	CO_2, CH_4, N_2O	0.4
MAt7. Regulation on Energy Management in the Transport Sector	CO_2, CH_4, N_2O	18
MAt8. Railway connection to Aveiro Sea Port	CO_2, CH_4, N_2O	40
MAt9. Shipping routes	CO_2, CH_4, N_2O	150
MAt10. Logistical Platforms	CO_2, CH_4, N_2O	Planning
MAt11. Restructuring of supply of CP (national railway) service	CO_2, CH_4, N_2O	44
Agriculture		
MRg1. IPPC Directive (Integrated Prevention and Pollution Control)	-	NA
MAg1. Evaluation and promotion of carbon sequestration in agricultural soil	CO_2	500
MAg2. Treatment and energy recovery of livestock waste	CH_4, N_2O	429
Land Use, Land Use Change and Forestry		
MRf1. Programme for the Sustainable Development of Portuguese Forests (in the context of IIIFSP)	CO_2	3743
MAf1. Promotion of carbon sink capacity of forests	CO_2	800
Waste		
MRr1. Directive on Packaging and Packaging Waste	CO_2, CH_4, N_2O	900
MRr2. Landfill Directive	CH_4	363
MRr3. IPPC Directive (Integrated Prevention and Pollution Control)	CO_2, CH_4	NA

NA: Not available

Source: IAa, 2006

The cross-cutting P&M adopted by Portugal include the European Union Emissions Trading System (EU-ETS), the Fluorinated Gases Directive and the Green Public Procurement System.

The total amount of emissions allowances awarded to Portugal in the 2005-2007 period is of 38.16 Mt CO_2 (representing approximately 47% of national emissions), of which 36.90 Mt CO_2 corresponds to the 244 installations listed in PNALE, and the remainder 1.26 Mt CO_2 is set aside as a reserve for new entrants. This reserve amount will be cancelled in case it is not used.

PNALE II[9] stipulates a limit value of 33.93 Mt CO_2/year to existing installations covered under the EU ETS, corresponding to a total of 169.65 Mt CO_2 for the period 2008-2012.

Portugal has participated regularly and systematically in the discussions on emissions from the **international air and maritime transport** sub-sectors, both at UNFCCC and Community levels (namely with regard to aviation), as well as in following developments by the International Civil Aviation Organisation (ICAO) and the International Maritime Organisation (IMO).

The National Civil Aviation Institute (INAC) is the responsible body for following issues relating to GHG emissions from the international civil aviation sector, ensuring the country's participation at the various international fora, both at the level of the ECCA[10] at the meetings of Director-Generals, and the ICAO, at the plenary sessions of the Assembly.

[9] June 2006 version, presently under public consultation.

[10] European Conference on Civil Aviation

The Port and Sea Transport Institute (IPTM) has been directly involved in the International Maritime Organisation through meetings of the Marine Environment Protection Committee. Portugal is preparing for the ratification of Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL).

Portugal's contribution to the **minimisation of the adverse effects of climate change** in other Parties, particularly developing countries, is carried out through a strong commitment to implementing the Convention and the Kyoto Protocol.

As such, the policies and measures implemented, adopted or foreseen in PNAC, targeting the six GHG of the Kyoto Protocol through its broad portfolio of instruments and wide-ranging coverage of all sectors of the economy, make up a significant effort by the Portuguese Government to address climate change, including the minimization of adverse effects of such policies.

In some cases, such as measures pertaining to the diversification of primary energy sources (namely shifting to natural gas), there can simultaneously be positive effects on Portugal's emissions reduction and in the economy of some fossil fuel exporting countries.

Portugal will resort to the flexibility mechanisms foreseen in the Kyoto Protocol in order to meet the emissions target defined in the context of the Protocol and the EU Burden Sharing Agreement.

As such, the Government established that the Climate Change Commission will act as the Designated National Authority (DNA) for the flexibility mechanisms, and created the Portuguese Carbon Fund. In order to carry out the competencies delegated in the DNA, an Executive Committee was created to manage the Portuguese Carbon Fund, in particular with regard to technical aspects such as:

- acquisition of GHG emissions credits, at competitive prices, through direct investments in the flexibility mechanisms of the Kyoto Protocol (Emissions Trading, Joint Implementation and Clean Development Mechanism projects);
- acquisition of GHG emissions credits, at competitive prices, through direct investments in funds managed by third parties or in other carbon market instruments;
- support to projects, in Portugal, which lead to a GHG emissions reduction, namely in the areas of energy efficiency, renewable energy, carbon sinks, CO2 capture and geological sequestration, and adoption of new technologies, as justified by the return in avoided emissions;
- promoting the participation of public and private bodies in the flexibility mechanisms of the Kyoto Protocol.

Finally, a series of memoranda of understanding on climate change and flexibility mechanisms with several parties have either been signed or are currently under negotiation.

Portugal's **National Registry System** is operational since November 2005. Such infrastructure meets the needs of the registry system and is capable of expanding to meet future requirements. An external team of Information Technology and Environment experts was hired to assist in the management of the registry system.

GHG Emissions Projections

Projection estimates for national anthropogenic GHG emissions are organised according to Intergovernmental Panel on Climate Change (IPCC)[11] sectors.

[11] In the Energy sector, Transport sub-sector is presented separately.

According to macroeconomic scenarios, there are three likely paths for the Portuguese economy in the period 2000-2020. Out of these, the two contrasting ones were adopted (high and low) for the purpose of GHG emissions projections in the reference scenario, to ensure compatibility, with greater probability, with the real evolution of the Portuguese economy.

These estimates are supported by the following:

- Expected emissions in the reference scenario, estimated on the basis of energy demand forecasts derived from macro-economic indicators, as well as from the implementation of sectoral policies and measures, adopted or in force on the 1st January 2005 (thus excluding the EU Emissions Trading Scheme) which bear an impact on GHG emissions reduction (including afforestation, reforestation and deforestation under art. 3(3) of the Kyoto Protocol); and
- GHG emissions reductions expected from the adoption of additional policies and measures undertaken with the objective of reducing GHG emissions (including forest management, cropland management and grazing land management activities under art. 3(4) of the Kyoto Protocol).

A set of additional policies and measures for the various sectors of activity were also defined and evaluated, in order to ensure full compliance with the Kyoto Protocol's GHG emissions targets. Several of these measures have been reassessed relative to PNAC 2004, within the frame of current sectoral policies. Chapter presents these additional measures and associated GHG targets, as well as the reduction potential. The total potential of the additional measures (including forest management, cropland management and grazing land management activities under art. 3(4) of the Kyoto Protocol) adds up to 3687 kt CO2e/year, which is over 5% of the net emissions balance estimated for the Reference Scenario.

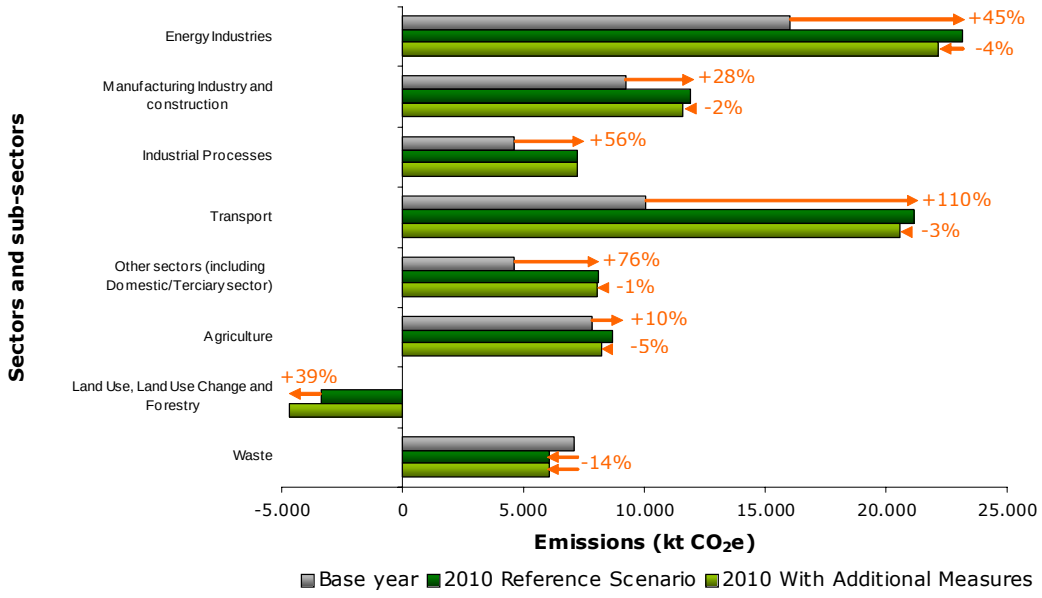

Figure 2. Trend in GHG emissions (1990-2010) estimated for the reference and with additional measures scenarios[12]

Source: IAa, 2006

[12] Industry and construction include emissions form combustion and processing.

Impacts, Vulnerability and Adaptation

The Climate Change in Portugal: Scenarios, Impacts, and Adaptation Measures (SIAM) project is the most comprehensive study on the impacts and vulnerability associated with climate change in Portugal. This study was based on future climate scenarios derived from atmosphere general circulation models, analysing its effects on a number of socio-economic sectors and biophysical systems including hydrological resources, coastal areas, energy sector, forests and biodiversity, fishing, agriculture and health. The first phase of this project examined mainland Portugal; a second phase extended the study to the autonomous regions of the Azores and Madeira.

The different climate scenarios show significant change to the Portuguese climate. A systematic increase in temperature in the order of 3 ºC to 7 ºC is estimated for the summer season in continental Portugal, affecting in particular inland Northern and Central regions. Increased frequency and intensity of heat waves is also foreseen. In the islands, the temperature increase is estimated to be more moderate, in the order of 1ºC to 2ºC in the Azores and 2ºC to 3 ºC in Madeira.

As a result of a reduction of the rainy season, different scenarios forecast a reduction in annual rainfall in the continent by 20-40% of current levels. The majority of the models predict a moderate increase in rainfall in the North in the winter season for the period 2070-2099 relative to the baseline period of 1961-1990. Model projections are more variable for the Centre and South in the winter season within this same period. A generalised reduction in rainfall is projected, particularly in the spring and autumn. A significant reduction (about 30%) in annual precipitation is also projected for Madeira during this period. In the Azores, changes are predicted in the annual rainfall cycle but without substantial impact on total precipitation.

The main impacts identified in the SIAM project include:

- probable changes in flood and drought regimes, as well as changes in the quality and availability of water;
- significant increase in the risk of fire hazards;
- considerable increase in air pollution levels and ecological disturbances, which may lead to significant changes in the dynamics of infectious disease transmission as well as regional variations in agricultural productivity;
- increase of the erosion processes and consequently of the flooded areas;
- reduction in the yield of irrigated crops.

The highest frequency of heat waves was recorded in the 1990s, with particularly long and widespread events in 1981, 1991, 2003 and, more recently, two heat waves between the end of May and June 2005.

A Contingency Plan for Heat Waves (PCOC) has, in the meantime, been approved due to the increased frequency of such events with effects on morbidity and mortality. The aim is to minimize the effects of high temperatures on health through a warning and adequate response system, to define guidelines for intervention and to strength the cross-institutional coordination. PCOC takes effect annually in the period from 15th May to 30th September.

Droughts are common in continental Portugal. However, its frequency and intensity have increased in the last decades of the 20th century. Drought was most severe in 1991/92, 1992/93, 1994/95, 1998/99, 1999/2000 and 2004/2005.

Forest fires associated with the heat wave of 2003 resulted in an extremely large burnt area of land - 425 000 ha, corresponding to approximately 13% of the total forest area in the country.

Financial commitments and Technology Transfer

The policy is defined in the frame of the International Development Agenda and in accordance with successive commitments undertaken in various international fora. It also aims at implementing, in a coherent, effective and up-to-date manner, a strategic cooperation framework whereby the fight against poverty, inequity and social exclusion in developing countries are high priorities. Furthermore, such policy will also reflect an enhanced inter-connection between bilateral and multilateral cooperation, so as facilitate a better integration of Portuguese cooperation and Official Development Assistance (ODA) in global strategies. In this backdrop, environmental issues, particularly those pertaining to climate change, are included in cooperation and ODA in an integrated way and mainstreamed in other intervention sectors like agriculture, fisheries, industry and tourism.

Most of Portuguese ODA, corresponding to an average of 67% of assistance between 2001 and 2004, is channelled bilaterally, mainly through grants with a strong technical cooperation component.

Table 2 below, shows ODA figures from 2001 to 2004.

Table 2. Total Official Development Assistance

	2001	2002	2003	2004
Bilateral ODA (MEuros)	204 695	197 443	161 494	702 446
Multilateral ODA(MEuros)	95 052	144 852	121 379	127 445
Total ODA (MEuros)	299 747	342 295	282 873	829 891
Total ODA (% GNI)	0.25%	0.27%	0.22%	0.63%

Source: IPADa, 2005

External assistance priorities are focused on Least Developed Countries (LDC) and the poorest Sub-Saharan African countries, particularly the five Portuguese-speaking African countries (PALOP) - Angola, Cape Verde, Guinea-Bissau, Mozambique and Sao Tome and Principe – and, more recently, East Timor which, in receiving on average 31% of bilateral ODA in the period 1999-2003, is the most significant beneficiary. Portuguese multilateral contributions represented between 38% and 51% of total external assistance in the period 2001-2003, with a sharp drop to 20% in 2004. This reduction is not due to a decrease in multilateral contributions, which in fact increased as an individual item by 17% relative to the previous year, but rather to the marked increase in total assistance resulting from the expansion of the bilateral component.

In order to resolve global environmental problems, including those stemming from climate change, Portugal contributed to the Global Environment Facility a total of USD 6.08 million in the period from 2001 to 2004.

Table 3. Financial contributions to the Global Environment Fund (millions of USD)

	Contribution			
	2001	2002[13]	2003	2004
Global Environment Fund (GEF)	1.09	0	3.21	1.78

Source: IPADa, 2005

Following the commitment by the EU, Canada, New Zealand, Norway and Switzerland at the Second Part of the Sixth Conference of the Parties in Bonn in 2001, to contribute annually with 410 million dollars for the support to non-Annex I countries in climate change related projects (Bonn Declaration), as well as decisions subsequently made within the EU, Portugal ensured in 2005 that its own share of annual international obligations were duly met, with a total contribution of around € 1 193 924[14].

[13] This value is explained by a delay in its accounting and was therefore subsequently compounded with the figure for 2003.

[14] USD 1 753 995 calculated using the exchange rate of the day of the transfer.

The funding available is new and additional relative to previous years, as it results from a new budget line of MAOTDR created specifically for this objective. Further to integrated support already provided to other projects, the management of this specific funding line, under the responsibility of the Institute for the Environment, will support projects conceived for the implementation of the Convention and the Kyoto Protocol, namely through mitigation and adaptation initiatives.

The referred funds will be managed so as to meet the objectives of the two regional networks established specifically to promote cooperation on the implementation of the Convention and Kyoto Protocol – the Portuguese Speaking Countries Climate Change Network[15] (RELAC) and the Iberian-American Climate Change Network (RIOCC). With similar objectives and formats, these networks differ mainly by their geographical scope, with RELAC being focused fundamentally in Africa while RIOCC focuses on Latin America. However, both these networks aim at promoting the exchange of knowledge and experiences between the regions, through specific mechanisms to be created.

Systematic Research and Observation

To reach the targets defined in the Lisbon Strategy and the Barcelona European Council Conclusions adopted in Barcelona, which encompasses the Bologna Declaration, Portugal has reformed the structure of public expenditure and the incentives system to encourage growth and to boost scientific and technological development and innovation. This task involves doubling the scientific and technological research capacity of the country, which in turn reinforces the social and economic potential of Portugal. In 2003 the total expenditure on R&D activities was 1020 million Euros, corresponding to 0.78% of the Portuguese GDP.

Of the Public Budgetary Appropriations for R&D in 2000-2004, 0.07% was allocated to climate change research. 2004, with an allocation of 0.14%, was the peak year for climate change research funding.

Activities relating to systematic observation follow policies determined by international organisations in which Portugal participates, including the World Meteorological Organisation (WMO) and the EU. Portugal is mainly involved through the World Climate Programme (WCP), its research component (WCRP) and the International Geosphere-Biosphere Programme (IGBP).

At the international level, Portugal contributes to the maintenance and improvement of the global observation system by taking part in Earth observation programmes, particularly satellite programmes of the Organisation for the Exploitation of Meteorological Satellite programmes (EUMETSAT) and the Global Climate Observing Systems (GCOS).

With regard to Portuguese Official Development Assistance ODA, it is worth noting the ongoing scientific and technical collaboration with institutions of the Portuguese Speaking Countries, namely in several operational and Research and Development projects, in particular with Sao Tome and Principe and Cape Verde, in the fields of Systematic Observation and models for weather, climate and ocean turbulence.

Within the framework of the Portuguese ODA, and in the context of the Bonn Declaration, several cooperation protocols were celebrated with Cape Verde and Sao Tome and Principe in 2005, for implementation of the Climate and Sea Information System for Sustainable Development (SICLIMAD) project in these countries. An identical protocol is expected to be signed with Guinea-Bissau in 2006.

[15] RELAC includes Angola, Brazil, Cape Verde, Guinea-Bissau, Mozambique, Portugal, Sao Tome and Principe and East-Timor, and is a fundamental instrument for networking between CPLP countries. It will facilitate the exchange of perspectives and experiences, as well as the preparation of joint proposals promoting action against climate change.

Public Education, Training and Awareness Raising

Climate change and other environmental issues are cross sectoral themes which are present in different forms in school curricula. In the current reorganisation of the curriculum for primary education and the revision of that for secondary education, this theme is specifically covered in some subjects.

Since the late 1970s, environmental themes have been introduced in school programmes. Since 1997, within the scope of the ME and the MAOTDR Cooperation Project (signed in 1996), teachers have been appointed to coordinate school projects for environmental education. During the 2003/04 school year, climate change was proposed to the teachers as theme for projects, awareness raising activities, training and other initiatives.

As for the involvement of environmental Non-Governmental Organisations (NGOs), this is possible through two financial support instruments: Programme for the Support of Environmental and Sustainable Development Activities (PAAADS) and the Financial Support Programme (PAFOE). In 2003 these two funding programmes supported 145 projects, involving 50 organizations amounting to about € 257 621. In 2004, 111 projects were supported, amounting to about € 221 041; in 2005, 134 projects were supported to a sum of € 237 156. Between 2004 and 2005, the overall funding for initiatives on training, awareness raising and education on climate change amounted to approximately € 36 485, spread across ten projects.

Due to their scope, Environmental NGOs play a very active role in public participation processes, while also having an equally important role raising awareness on environmental problems.

The IA has financed, under PAAADS, the participation of ENGOs at various national and international events which contribute to the increase in the capacity of work done by the benefiting entities, mainly by supporting the participation at the Conferences of the Parties (COPs). Such supported has amounted to a total of about € 9400 in the 2000-2005 period.

1 National Circumstances

1.1 Government Structures and Decision-making Process

The Portuguese Republic is a democratic State that is based upon the rule of law, the sovereignty of the people, the pluralism of democratic expression and democratic political organisation, and respect and effective guarantees for fundamental rights and freedoms and the separation and inter-dependence of powers. The State is a unitary State that is structured and functions under the rule of the self-governing system of the islands and the principles of the subsidiarity, the autonomy of local authorities and the democratic decentralisation of the public service. The archipelagos of the Azores and Madeira shall constitute autonomous regions with their own political and administrative statutes and their own institutions of self-government.

Portugal's constitutional system foresees four sovereign organs: the President, who represents the Portuguese Republic; the Government, which leads the country's general policies and is the supreme organ of the Public Administration; the Assembly of the Republic (Parliament), which represents the Portuguese citizens; and the Courts of Law, which administer justice and which rulings are mandatory for all public and private entities. These entities are independent but obliged to cooperate among each other. The people through direct, secret and periodical suffrage elect both the President and the Parliament.

The Parliament is elected every four years and consists of a maximum of two hundred and thirty Members. It takes on several political and legislative functions as well as that of inspection of governmental and administrative acts.

The President of the Republic appoints the Prime Minister, after consultation with the parties represented at the Parliament and according to the electoral results. The President also appoints the other members of the Government, after having been proposed by the Prime Minister. The number, designation and appointments of the Ministries and the Secretariats of State, as well as their respective coordination, are defined by the nomination Decrees of the corresponding position holders or by Decree-Laws.

The Government takes on competencies in political, legislative and administrative functions, specifically, to negotiate and to agree international Conventions, to approve international agreements which approval is not within the powers of the Parliament or which have not been tabled before the Assembly, and to table bills and draft resolutions before the Parliament. The Government is responsible for its actions to the President of the Republic and to the Parliament.

In relation to climate change, the Government holds the full responsibility of assuring the fulfilment of internationally commitments undertaken in the frame of the United Nations Framework Convention on Climate Change (the Convention) and the Kyoto Protocol.

In 2001, the Government approved the National Strategy on Climate Change[16], which entrusts the Ministry for Environment, Spatial Planning and Regional Development (MAOTDR) the responsibility for spearheading and co-ordinating at Government level the development of programmes and actions to limit GHG emissions growth.

According to the organisational structure of MAOTDR, climate change affairs fall directly under the Secretariat of State for Environment (SEA). The line agency with leading competences on climate change policy is the Institute for the Environment (IA). The IA's responsibilities include promotion, co-ordination and support to the various issues related to climate change. Thus, the IA assumes the role of Focal Point to the Convention, competent authority in the context of the European Union Emissions Trading Scheme (EU-ETS), and responsible entity for the National System for the Estimation of Emissions by Sources and Removals by Sinks of Air Pollutants (SNIERPA).

[16] Council of Ministers Resolution 59/2001, of 30 May.

Given the transversal nature of issues related to climate change, the Government established in 1998 the Climate Change Commission[17] (CAC). The CAC is tasked with promoting and facilitating climate change policy across the range of Government bodies with relevant competencies, as well as to ensure that such issues are duly considered in the full range of sectoral policies.

The CAC is co-ordinated by the MAOTDR and includes representatives from the Ministry of Internal Administration (MAI), Ministry of Foreign Affairs (MNE), Ministry of Finance and Public Administration (MFAP), Ministry of Economy and Innovation (including energy and industry) (MEI), Ministry of Agriculture, Rural Development and Fisheries (including forests) (MADRP), Ministry of Public Works, Transports and Communications (MOPTC), Ministry of Education (ME), Ministry of Science, Technology and Higher Education (MCTES), as well as representatives from the Autonomous Regions of Azores and Madeira.

Technical options and adequate policies are discussed within the remit of the CAC. Programmes, plans and legal instruments pertinent to the national policy framework on climate change are proposed for adoption by the Council of Ministers with the objective of complying with Portugal's commitments under the Kyoto Protocol and the European Union Burden Sharing Agreement.

The CAC was recently appointed Designated National Authority (DNA) for the Kyoto Protocol flexibility mechanisms, responsible for, among other functions, promoting Portuguese investments in these mechanisms.

The main instruments geared towards compliance with the national GHG emissions target and, more broadly, the implementation of the Kyoto Protocol include the National Climate Change Programme[18] (PNAC), the Monitoring and Assessment Programme of PNAC[19] (PNACm), the National System for the Estimation of Emissions by Sources and Removals by Sinks of Air Pollutants [20] (SNIERPA), the participation in the EU-ETS as defined by the National Allocation Plan[21] (PNALE) and the Portuguese Carbon Fund[22].

Policies and measures included in the PNAC are pursuant to European Community (EC) Directives transposed into national legislation and the application of other types of EU instruments, namely in the context of the European Climate Change Programme (ECCP), as well as measures specifically developed by Portugal. Both the framework programmes and the specific instruments for the limitation of national GHG emissions have been approved by Government and duly published in the *Diário da República*[23].

At the local level, and within the spirit of Local Agenda 21, Local Authorities have a very important role in implementing policies and measures, as well as promoting awareness on issues relating to climate change, as these are the governmental bodies closest to the citizens and also the ones that can drive significant changes, especially in the behaviour of individuals and small and medium enterprises.

1.2 Geographic and Climate Profile

Portugal comprises three territorial areas: the mainland, within the European continent, and the archipelagos of the Azores and Madeira (92 151.8 km^2).

[17] Council of Ministers Resolution 72/1998, of 29 June, altered by Council of Ministers Resolution 59/2001, of 30 May.

[18] Approved by Council of Ministers Resolution 119/2004 of 31 July.

[19] Council of Ministers Resolution 59/2005, of 8 July.

[20] Council of Ministers Resolution 68/2005, of 17 March.

[21] Council of Ministers Resolution 53/2005, of 3 March.

[22] Decree-Law 71/2006, of 24 March.

[23] Official Gazette.

Mainland Portugal is located in the Southwest corner of Europe, between the latitudes of 37 °N and 42 °N and the longitudes of 9.5 ºW and 6.5 ºW. With a total surface area of 89 045.1 km^2, mainland Portugal is divided into eighteen Districts grouped into five Regions (North, Centre, Lisbon and the Tagus Valley, Alentejo and the Algarve), has roughly 1450 km of coastline and shares a 1200 km boarder with Spain. The archipelago of the Azores has a total surface area of 2321.9 km^2, and is located approximately 1200 km West of the mainland. The archipelago of Madeira has a total surface area of 784.8 km^2, and is located approximately 900 km Southwest of mainland Portugal (Figure 3).

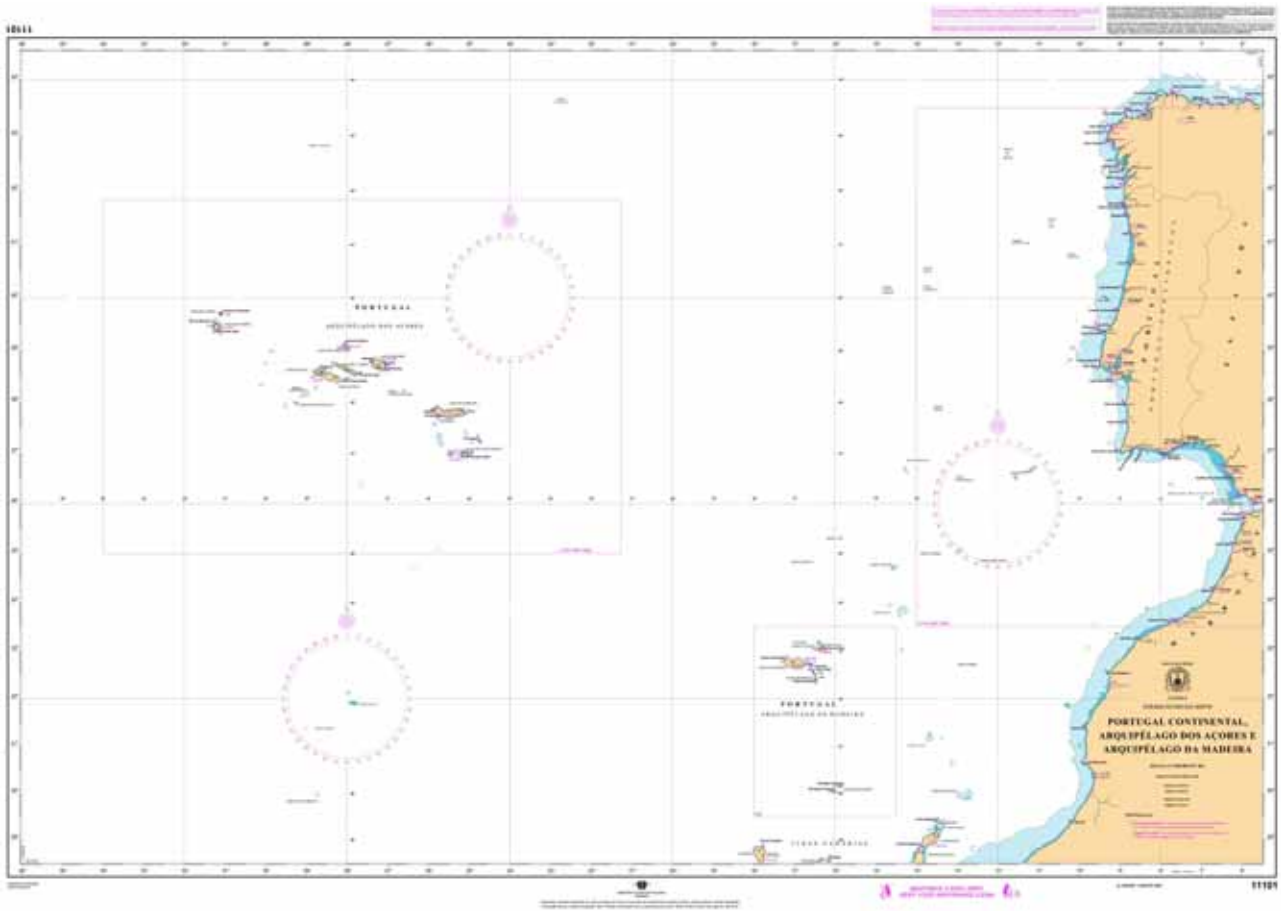

Figure 3. Portugal's geographic location

Source: http://www.portugal.gov.pt

The major rivers in Portugal are the Tagus, the Douro, the Guadiana and the Minho, which hydrological basins are shared with Spain, as is that of the river Lima. These shared basins occupy 264 560 km^2 - 56 930 km^2 located in Portugal and 207 630 km^2 in Spain. The exclusively national rivers are smaller and more irregular, the most important of which are the Vouga, the Mondego and the Sado.

In the Northern region of Portugal (North of the Tagus) the terrain is mountainous, with altitudes between 400 m and a maximum of 1991 m, with the exception of the plains of the Tagus and Vouga rivers. The soils are predominantly acidic, though neutral soils can be found in the Centre region. South from the Tagus, in the Alentejo region, the altitude varies from 50 m to 400 m, with a variety of predominantly acidic and neutral soils. The far South, the Algarve, presents a continuous coastal strip of plains (with an altitude range from 0 m to 50 m), with acidic soils in the plateaus and predominantly alkaline and neutral soils in the plains.

Portugal is located in the transition area between the subtropical anticylone of the Azores and the subpolar depression region. The factors that most influence the weather conditions in mainland Portugal are latitude, topographic relief, the influence of the Atlantic Ocean and its continentality. Although these factors show limited variation, there is still a significant differences in the meteorological parameters, namely in air temperature and precipitation. The annual cycles of mean monthly temperature (minimum and maximum) and precipitation indicate a warm and dry summer period, markedly in the Southern regions (Figure 4).

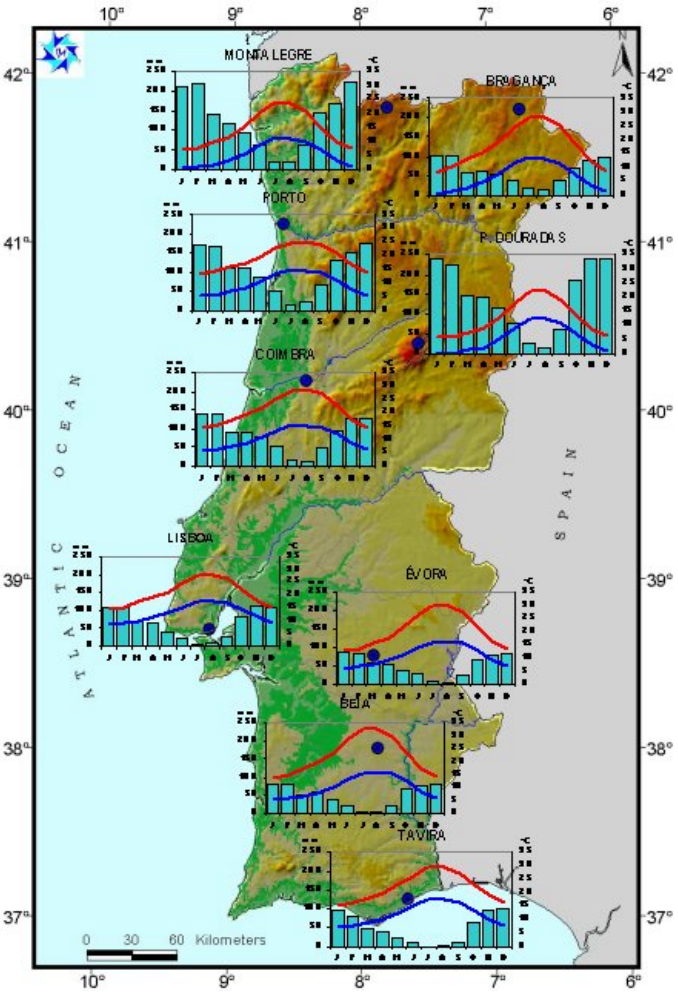

Figure 4. Mean annual cycles of monthly temperature (minimum and maximum) and precipitation (1961-1990)

Source: IM, 2005

The mean annual air temperature varies from a minimum of 7 ºC in the Central interior highlands (Serra da Estrela) to a maximum of 18 ºC along the Southern coastline. The mean monthly temperature values vary regularly throughout the year, with the maximum values being registered in August and minimum in January. In the summer, the mean maximum temperature values vary between 16 ºC in the Serra da Estrela and 32 ºC to 34 ºC in the interior Central region and the Alentejo. The mean minimum temperature values in the winter vary between 2 ºC in the interior mountainous regions and 12 ºC for the Southern coastline (Figure 5).

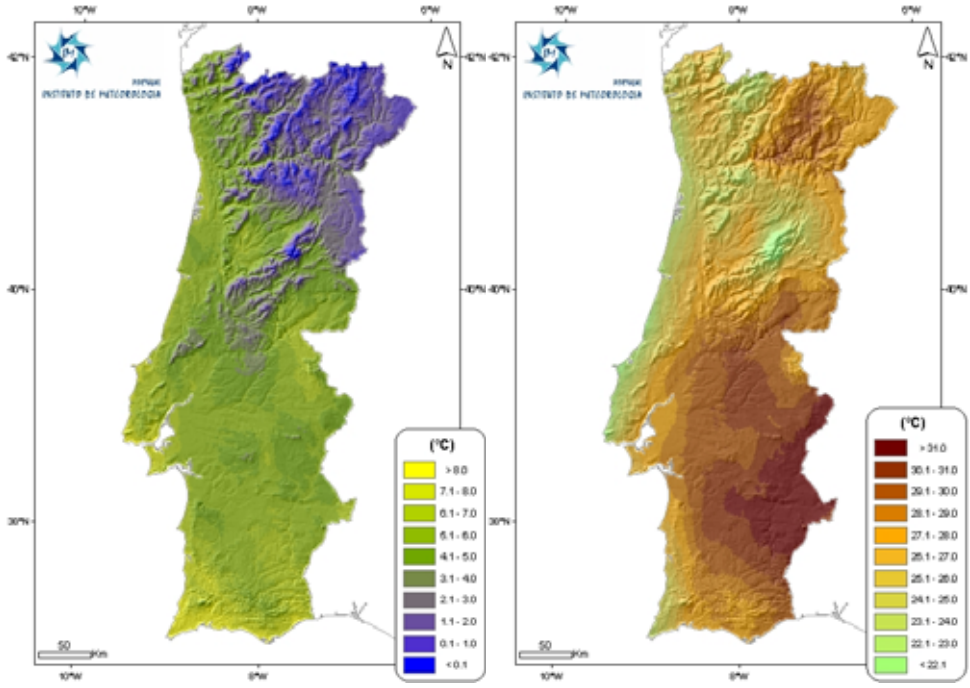

Figure 5. Mean values for minimum winter temperature and maximum summer temperature, and mean annual temperature (1961-1990)

Source: IM, 2005

Analysed data indicates that the Portuguese climate underwent a change throughout the 20th century characterised by two warming periods, with a cooling period in between. This is in line with the registered global tendencies.

The mean temperature has risen in all of Portugal's regions since the 1970s, at a rate of approximately 0.15 ºC/decade. The time-series analysis of the mean annual temperature since 1931 (Figure 6) shows that 1997 was the warmest of the last 75 years and that 5 of the 10 warmest years occurred in the 1990s (1997, 1995, 1996, 1990 and 1998).

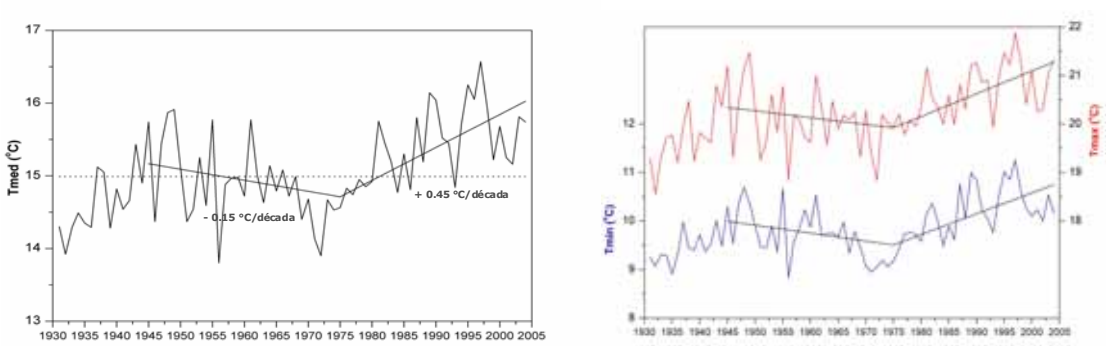

Figure 6. Variation in mean annual temperature (left) and maximum and minimum temperature (right) in mainland Portugal (1930–2005)

Source: IM, 2005

A significant increase in temperature maximums and minimums (Figure 6) was noted; trends for both extremes were comparable.

In 2005, the mean maximum temperature was of 21.55 °C, 1.36 °C higher than the mean value recorded in the period from 1961 and 1990, and corresponding to the second highest value since 1931. The mean minimum temperature was of 9.68 °C, 0.07 °C below the mean value registered in the same period. Since 1987, the mean annual minimum temperature has not been lower than the corresponding mean during the period 1961 – 1990.

An analysis of temperature indices indicates that the increase of the mean temperature is accompanied by a change in the frequency of very hot days and a decrease in the frequency of very cold ones.

The heat wave duration index has also been rising. Heat waves occur when, in a period of at least 6 consecutive days, the daily maximum temperature is 5 ºC higher than the daily mean value of the reference period, between 1961 and 1990. Although they can occur at any time of the year, heat waves have a more significant impact in the summer months. Heat waves were more frequent in the 1990s. The heat waves of 1981, 1991, 2003 and, more recently, the two registered in June 2005 were of particular significance due to their duration and spatial extension.

The cold spell duration index has been significantly decreasing over the last 20 years. Cold spells occur when, during a period of at least 6 consecutive days, the daily minimum temperature is 5 ºC lower than the mean daily value of the reference period, between 1961 and 1990. The February 1983 cold spell was the longest and most widespread in the last 25 years.

Mean annual precipitation over mainland Portugal is of about 900 mm, though with considerable spatial variability; the coastal North has the highest precipitation levels (3000 mm) while the lowest (under 400 mm) are observed in a very restrictive are of the interior North and, more extensively, in the interior South, with values below 600 mm.

On average, about 42% of the annual precipitation takes place during the winter (from December to February), and the lowest precipitation values, corresponding to only 6% of the annual total, occur during the summer (from June to August). Spring (from March to May) and Autumn (from September to November) show an extremely variable interannual distribution (Figure 7).

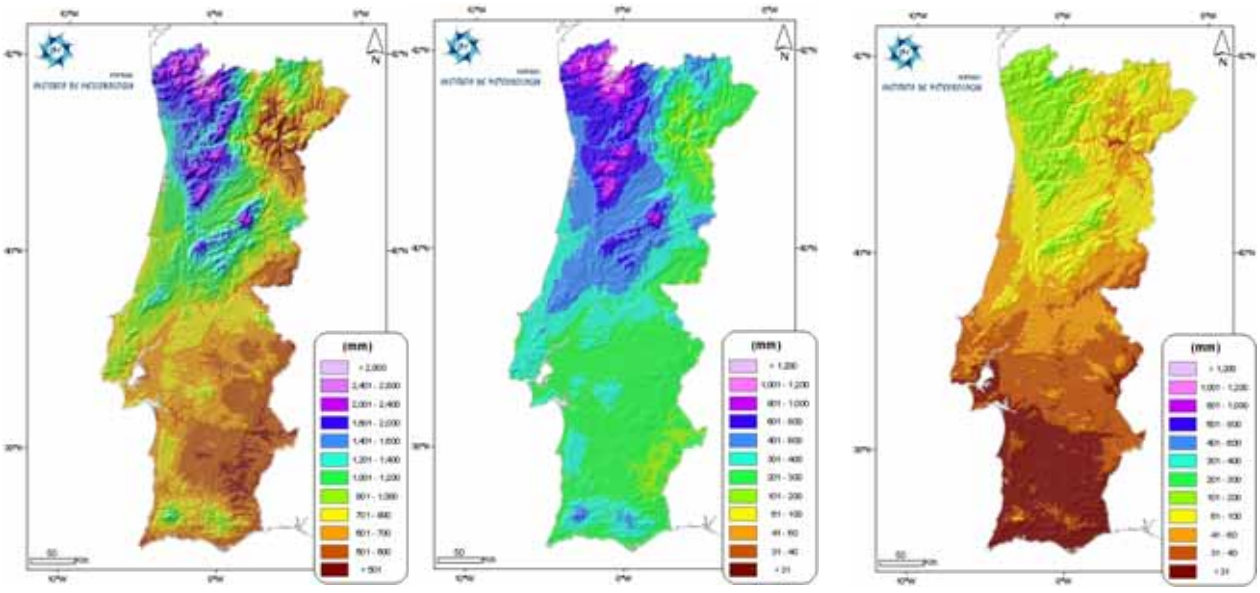

Figure 7. Mean annual precipitation in mainland Portugal (left), winter precipitation (centre) and summer precipitation (right) (1961-1990)

Source: IM, 2005

The spatial distribution of the average number of days of the year with a precipitation value higher than 0.1 mm is similar to the distribution of annual precipitation, with a maximum value registered in the Northern coastal region, where the values rise up to 150 days, and the minimum values observed in the South (about 65 days).

The average number of days in the year with precipitation equal to or higher than 10 mm (heavy precipitation) varies between 15 and 25 days in the Centre and Southern coast and the interior lowlands, between 25 and 50 in the Northwest and between 50 and 65 in the highlands.

The last 2 decades of the 20th century were particularly dry in mainland Portugal as opposed to the average values registered between 1961 and 1990. In fact, only in 6 of the last 20 years of the past century was the annual precipitation higher than the average. In 2001 and 2002, however, the annual precipitation values were higher than the average observed in the reference period. The driest of the past 75 years was 2005, and 2004 was the second driest on record (Figure 8).

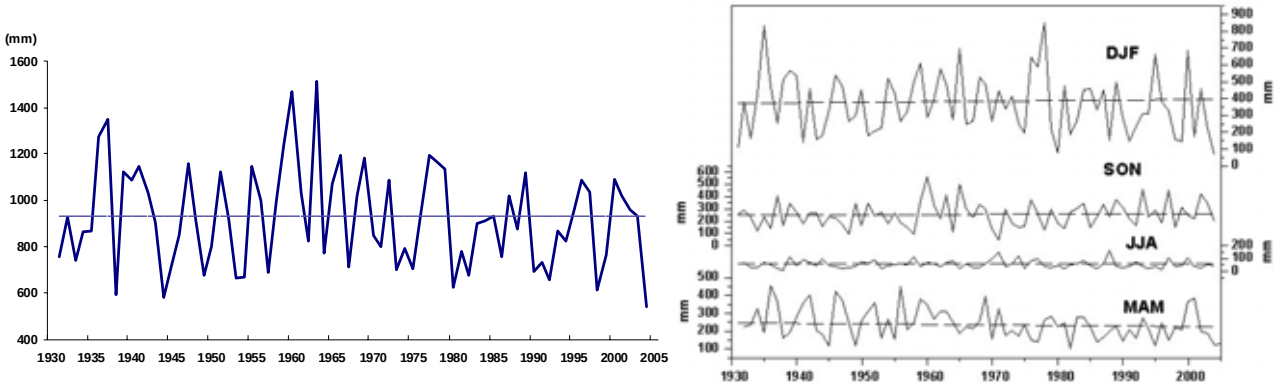

Figure 8. Variability of annual and seasonal precipitation in continental Portugal (1930–2005)
Source: IM, 2005

The seasonal trend in the mean precipitation values recorded since 1931 shows a systematic and statistically significant reduction in precipitation in the spring over the last three decades of the 20th century, with slight increases during the other seasons. In 2000 and 2001, spring precipitation rose to values not observed since the late 1960s.

Annual variability of winter precipitation increased over the last 30 years, with the occurrence of both drier and rainier winters. The winter of 2000/2001 was particularly rainy (the third most rainy of the last 30 years), and winter of 2001/2002 was the fifth driest of the last 3 decades. The winter of 2004/2005 was the driest winter observed in the last 75 years.

Average annual sunlight hours decrease, generally, form South to North with altitude and from East to West. The lowest values of sunlight incidence, 1600 to 2200 hours, are recorded in the Northwest of the mainland (in the highlands and in the Alto Minho). The highest values are observed in the Southern coast, the Eastern Alentejo and the Lisbon region, with values that vary from 2600 to 3300 hours (Figure 9).

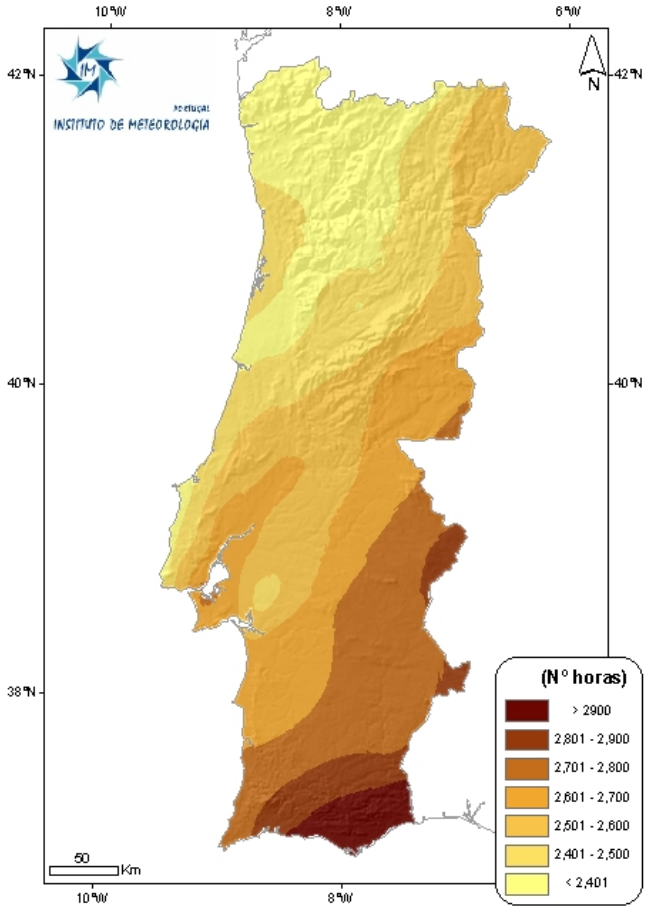

Figure 9. Annual hours of sunlight in mainland Portugal (mean values 1961-1990)
Source: IM, 2005

All models from the different scenarios forecast a significant increase in the mean temperature for all regions of Portugal until the end of the 21st century. In the mainland, summer maximum temperature increases are estimated to vary between 3 ºC and 7 ºC in coastal and interior areas, respectively, accompanied by a strong increment in the frequency and intensity of heat waves.

With regard to precipitation, future climatic uncertainty is considerably stronger. Nevertheless, most models project a reduction in total precipitation in all regions, with more intense periods of rain in shorter time frames in the winter.

Archipelago of the Azores

The archipelago of the Azores is situated between the latitudes of 36º45' N and 39º43' N and the longitudes of 24º45' O and 31º17' O, with the Easternmost point at a distance of about 1400 km off the Western coast of mainland Portugal. The Azores comprises nine islands which are divided into three groups: the Eastern (Sao Miguel and Santa Maria islands), Central (Terceira, Graciosa, Sao Jorge, Pico and Faial islands) and Eastern Isles (Flores and Corvo islands). The lowest island (Graciosa) has a maximum elevation of 402 m, whereas Pico has the highest point of the Azores and of Portugal (2351 m).

The Azores archipelago is located in the subtropical area of the Northern hemisphere anticyclones. The most determining factor that influences the weather conditions is the Azores antyclone.

The climate in this archipelago is temperate and humid. Given the altitudinal temperature variation, the climate is rainy and cool in high altitude regions. The season between September and March is predominantly rainy, characterized by the frequent passage of depression disturbances related to the polar front. In the remaining months the anticyclone's influence reduces precipitation.

Archipelago of Madeira

The archipelago of Madeira is located in the North Atlantic, 1300 km from the Azores and 900 km from the European continent. It comprises Madeira and the Porto Santo islands and two groups of deserted islets, the Desertas and the Selvagens.

Madeira island has a total surface area of 728 km^2 and is located at 32º45' N and 17º00' W. Madeira has an uneven orography; the highest points of the island, Pico Ruivo (1862 m) and Pico do Areeiro (1818 m), can be found on the Eastern side of the higher altitude formations, while to the West, the Paul Plateau rises to over 1400 m. Porto Santo Island is located roughly 40 km Northwest of Madeira and has a maximum altitude of 517 m (Pico do Facho).

The climatic conditions are moderate, both during the winter and the summer, except for in the highlands where there are lower temperatures. The island's complex relief creates many micro-climates.

Mean annual temperature can vary between 8 ºC in higher altitude and 18 ºC to 19 ºC in the coastal areas. From among the weather parameters, precipitation registers the broadest variability. Annual precipitation in Madeira varies between 3400 mm (highest points) and 600 mm (Funchal basin). There is a significant contrast between the Northern bank and the highest spots, where abundant precipitation occurs, and the Southern bank.

The North/South asymmetry in the annual number of days with precipitation is very clear; in the Funchal area and in other parts of the Southern coast, there are less than 80 days with precipitation per year, whereas in the Northern coast over 120 days/year are registered. In the highlands there are over 200 days with precipitation per year, 70 of which have high values of precipitation (more than 10 mm). The minimum number of days with precipitation occurs on the Southern coast (in the Funchal area) and also on the Eastern coast (Machico area).

1.3 Population Profile

The resident population in Portugal on 31 December 2004 was estimated at 10 529 255 individuals, an increase of 5.6% over the 9 970 441 individuals estimated for 31 December 1990.

Population figures have been rising slightly since 1992, and the 2001 registered the highest variation (approximately 80 thousand) (Table 4).

The slight rise in population occurred mainly due to the annual net migratory balance, given that the natural balances, though positive, have remained low. In 1990 a natural balance of 13 553 was registered, which decreased to 7330 in 2004. However, the migration growth rate grew from -0.39% in 1990 (emigration prevailed) to 0.45% in 2004 (immigration prevailed).

Simultaneously, Portugal has seen its population aging, whether through the reduction of the younger population (younger than 15 years old) resulting from low birth rates, or due to the increase of the elder population (65 years and older), a consequence of the increase in average life expectancy at birth and of a higher number of individuals attaining older age brackets. In 1990, 20.0% of the resident population was younger than 15 years old and 13.6% was 65 years old or older; in 2002 the proportion of the elderly (16.4%) exceeded that of youth (16.0%), a tendency observed also in 2004 (17.0% elderly and 15.6% youth). The level of demographic change is presented in Table 4.

From 1991 to 2001 the tendency to concentrate the population along the mainland's coast remained evident (namely in the Central and Northern regions). Population growth in some interior counties, especially District Capitals and their bordering counties contributed to reinforcing a network of medium-sized cities (Figure 10).

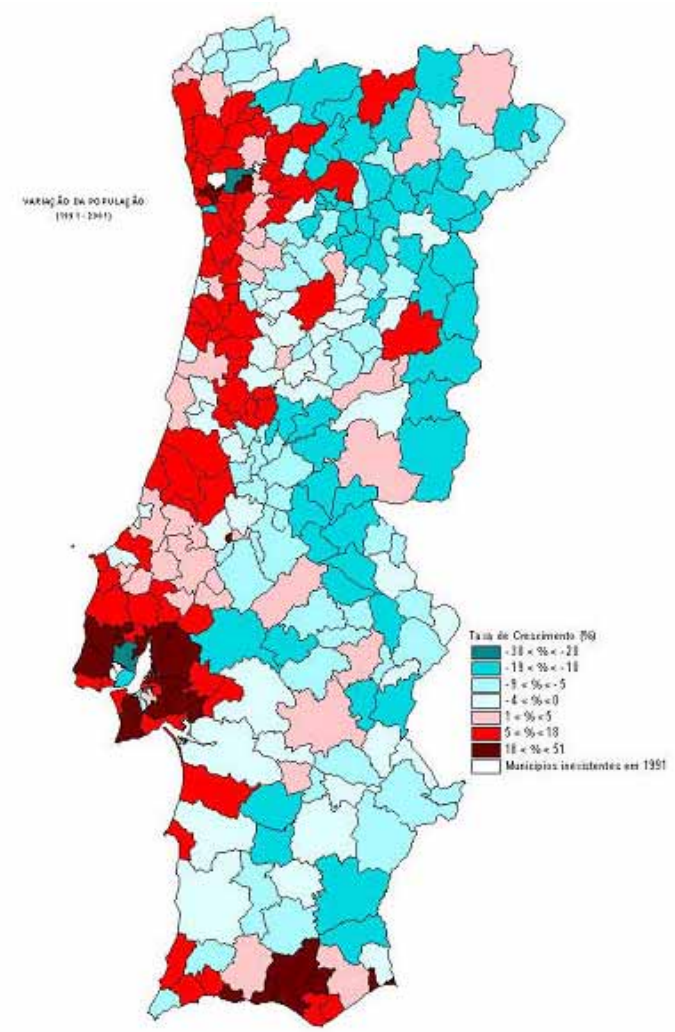

Figure 10. Variation in population (1991–2001)

Source: IAa, 2005

In the same period, there was a population decrease in the Alentejo region, the inner North and Centre regions and in some areas of the Tagus Valley, as opposed to the strong growth observed in the Metropolitan Areas of Lisbon and Oporto, along the coast North of the Tagus and in the Algarve. Nevertheless, the central core of the metropolitan areas, i.e. Lisbon and Oporto, underwent a considerable population decrease, which aggravated the abandonment of the historical town centres. As a consequence, there was a rise in mobility needs, especially in relation to commuters from urban peripheries.

Over the last decade, there was a strong expansion in the housing stock; the number of total lodging facilities in the country increased about 21%. Such an increase was felt all over the country, especially in the Algarve and in the North, where the lodging growth rates were higher than the national average. Over one third of existing national housing stock can be found in the North region, followed by the Centre region and Lisbon and the Tagus Valley. The remaining regions represent, on aggregate, less than a quarter of the total housing stock.

Table 4. Population in Portugal by age group, natural change and migration rate (1990–2004)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Resident population	9 970 441	9 965 315	9 974 591	9 990 590	10 017 571	10 043 180	10 072 542	10 109 697	10 148 883	10 195 014	10 256 658	10 329 340	10 407 465	10 474 685	10 529 255
Population 0 - 14 years	1 993 079	1 928 457	1 875 558	1 836 005	1 795 798	1 756 829	1 725 384	1 696 681	1 673 072	1 654 678	1 640 675	1 640 160	1 645 753	1 648 996	1 647 437
Population 15 - 64 years	6 620 653	6 648 818	6 682 689	6 710 461	6 746 534	6 778 260	6 808 563	6 840 153	6 871 182	6 905 459	6 938 696	6 980 609	7 026 170	7 064 293	7 091 279
Population > 65 years	1 356 709	1 388 040	1 416 344	1 444 124	1 475 239	1 508 091	1 538 595	1 572 863	1 604 629	1 634 877	1 677 287	1 708 571	1 735 542	1 761 396	1 790 539
Natural balance	13 553	12 417	14 276	7999	9981	3609	3362	8155	7186	8131	14 644	7682	8125	3720	7330
Migration rate (%)	-0.39	-0.18	-0.05	0.08	0.17	0.22	0.26	0.29	0.32	0.37	0.46	0.63	0.68	0.61	0.45

Source: INEa, 2005

1.4 Main Economic Indicators

From 1990 to 2003, the contribution of industrial sectors to the national Gross Value Added (GVA) decreased from about 26% to 19% (the weight of the extraction industry is almost marginal when compared to that of the processing industry), which reflects a deindustrialization process and a transformation to a services-based economy, demonstrated by the sectoral distribution numbers of the GVA (Table 5). Table 6 shows the trend in some national economic indicators for the period 1996 to 2005.

The trend indicates that the industrial sector has been undergoing a decrease in its contribution to total GVA, whereas no tendency can be discerned for agriculture, animal production, hunting and related services. The service sector, however, has increased its contribution to the GVA.

Table 5. Contribution of the agriculture, hunting and industrial sector activities to the total GVA at constant prices (1995–2003, base 2000)

Sub-sectors	Year								
	1995	1996	1997	1998	1999	2000	2001	2002	2003
Agriculture, animal husbandry, hunting and activity of related services	**5.7**	**5.5**	**4.6**	**4.3**	**4.0**	**3.8**	**3.6**	**3.3**	**3.4**
Agriculture, animal husbandry, hunting and forestry	5.3	5.5	4.6	4.3	4.0	3.8	3.6	3.3	3.4
Fisheries	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3
Extraction of energy products									
Extraction industries except the extraction of energy products	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.3
Industry	**22.0**	**22.5**	**22.1**	**21.8**	**21.0**	**20.0**	**19.5**	**19.2**	**18.7**
Food, drinks and tobacco industries	2.4	2.5	2.4	2.5	2.6	2.4	2.4	2.5	2.4
Textile industry	3.4	3.4	3.2	3.0	2.9	2.7	2.6	2.6	2.5
Leather industry	1.0	1.0	1.0	0.9	0.8	0.8	0.8	0.7	0.7
Wood and cork industries, and respective works	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.6
Pulp and paper industries and respective products; publication and printing	1.9	1.7	1.7	1.6	1.6	1.8	1.6	1.5	1.4
Manufacture of coke, refined oil products and nuclear fuel	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.0	-0.1
Manufacture of chemical products and synthetic or artificial fibres	1.3	1.3	1.3	1.0	0.9	0.9	0.9	0.9	0.9
Manufacture of rubber products and plastic substances	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5
Manufacture of other non-metallic mineral products	1.9	1.9	1.9	1.9	1.9	1.7	1.6	1.6	1.4
Metallurgical and metallic products industries	1.8	1.7	1.7	1.8	1.7	1.7	1.6	1.5	1.5
Manufacture of machines and equipment n.s.	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Manufacture of electrical and optical equipment	1.2	1.4	1.4	1.3	1.3	1.2	1.2	1.0	1.1
Manufacture of transport material	0.6	1.1	1.2	1.2	1.1	1.1	1.1	1.0	1.1
Processing industries n.s.	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Generation and distribution of electricity, gas and water	2.9	2.9	2.7	2.8	2.6	2.4	2.4	2.5	2.5
Construction	6.3	6.5	7.0	7.3	7.3	7.6	7.8	7.6	6.7

Sub-sectors	Year								
	1995	1996	1997	1998	1999	2000	2001	2002	2003
Services	**65.9**	**65.5**	**66.2**	**66.7**	**67.7**	**68.6**	**69.1**	**69.9**	**71.2**
Gross and retail commerce, repair of vehicles, motorcycles and goods of personal and domestic use	14.1	13.7	13.8	13.8	13.4	13.4	13.6	13.4	13.2
Accommodation and restaurants	3.7	3.6	3.8	4.0	4.0	4.1	4.0	4.2	4.2
Transports, storage and communications	6.5	6.6	6.6	6.5	6.6	6.6	6.8	6.8	7.0
Financial activities	6.3	5.8	6.2	6.2	6.0	6.1	6.5	6.3	6.6
Real estate activities, leases and provision of services to enterprise	13.6	13.5	13.5	13.9	14.7	14.5	14.0	14.1	14.2
Public administration, defense and compulsory social security	8.1	8.2	8.2	8.2	8.5	8.9	8.7	8.9	9.1
Education	6.2	6.3	6.4	6.4	6.5	6.6	6.7	7.0	7.1
Health and social services	4.9	5.0	4.9	5.0	5.2	5.4	5.8	6.0	6.4
Other activities of collective, social and personal services	1.9	2.0	2.1	2.0	2.2	2.4	2.3	2.4	2.5
Families with household employees	0.7	0.8	0.8	0.7	0.7	0.7	0.7	0.8	0.8

n.s. – non specified

Source: INE, 2006

1.5 Energy

In 2004, the Energy sector, which consists of the activities of production, transformation and energy products distribution (coal, crude oil and derivatives, gas and electricity), represented 2.8% of the GDP. The electricity sub-sector gained standing, with 67.1% of the sector GVA. Similarly, with 67.9% of the sector total, the electricity sub-sector is responsible for 4% of the Gross Fixed Capital Formation (GFCF) registered in 2004.

From 1990 to 2004, primary energy consumption grew at an annual rate of about 3%. In 2004, Portugal registered per capita consumption of 2.51 toe, contrasting with the 1990 value of 1.78 toe per capita. Crude oil consumption increased at a rate similar to that of total consumption. In relative terms, this energy product maintains an important role in the supply chain, representing 58.3% of total primary energy consumption in 2004, as opposed to 71.4% in 1990. This decrease is partly due to the introduction of natural gas in 1997, which allowed for the diversification of the energy supply structure and reduction in dependency on external sources of crude oil. Natural gas has increased its penetration within the energy mix, representing in 2004 12.5% of total primary energy consumption. Currently, about 95.4% of primary energy consumed in Portugal is imported. In 2004, net energy imports represented almost 9% of the total entries of FOB goods[24].

Energy related emissions depend on the type of fuel and its carbon intensity. On average, during the time frame considered, 84% of primary energy consumed was produced from fossil fuels (coal, crude oil, natural gas); renewable energy sources (domestic) represent the remaining 16% (Figure 11).

[24] FOB (Free on Board) Price: price charged at the loading station.

Table 6. Gross Domestic Product and related indicators (1996-2005)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Millions of Euros										
GDP (Volume Chain-linked series)	103 707.9	108 052.8	113 196.9	117 652.5	122 270.1	124 735.1	125 686.5	124 279.2	125 623.6	126 045.5
Variation in volume (%)										
GDP (Volume Chain-linked series)	3.6	4.2	4.8	3.9	3.9	2.0	0.8	-1.1	1.1	0.3
Final Consumption Expenditure (Resident families and ISFLSF[25])	3.3	3.6	5.3	5.3	3.7	1.2	1.3	0.1	2.4	2.0
Final Consumption Expenditure (Public Administration)	3.3	2.2	4.3	5.6	3.5	3.3	2.6	0.3	2.0	1.7
Investment (GFCF[26])	4.2	13.4	13.1	7.4	2.1	1.2	-4.7	-9.7	1.8	-3.6
Internal Demand	3.5	5.5	6.9	5.8	3.3	1.7	0.0	-2.2	2.2	0.7
Exports	5.7	6.1	8.5	3.0	8.4	1.8	1.5	3.7	4.5	0.9
Imports (FOB[27])	5.2	9.8	14.2	8.6	5.3	0.9	-0.7	-0.4	6.8	1.8

Source: INE, 2006

[25] Not for profit institutions providing family support services

[26] Gross Fixed Capital Formation

[27] Free on Board

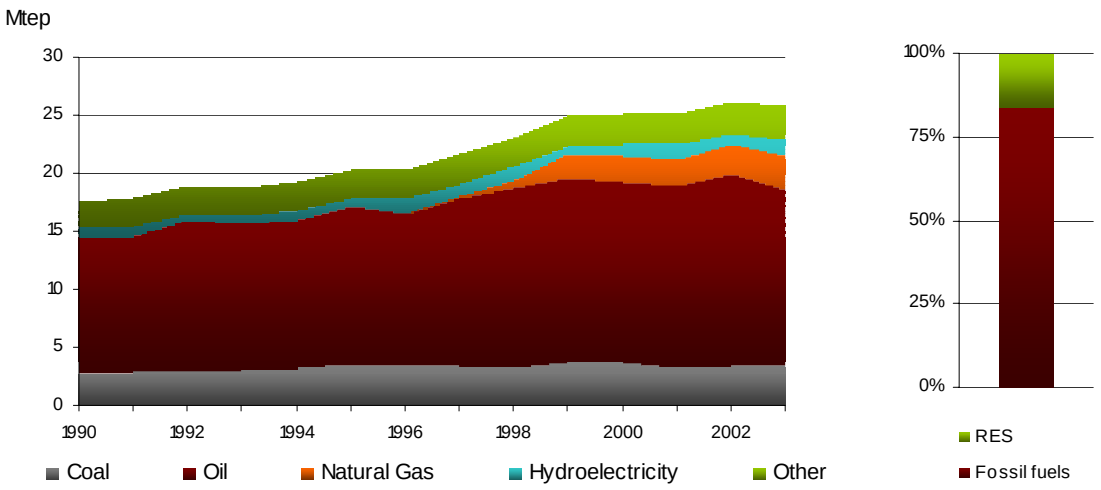

Figure 11. Primary energy consumption and average primary energy consumption from fossil fuels and renewable energy sources (1990-2003)[28]

Source: DGGEa, 2005

The generation of electric energy from renewable energy sources (RES) is directly linked to variations in large hydro production, as the latter represents almost 87% of the RES total. Attaining Portugal's target for electricity generation from RES (39% of gross national electricity consumption) by 2010[29] strongly depends on this energy source.

Given the strong oscillations in hydroelectric production, the gross RES contribution to primary energy consumption is highly irregular. The average annual contribution by RES to electricity generation was of 32% in the period from 1997 to 2004. Corrected by the hydraulic index (IPH) on a yearly basis, and considering an average rainfall regime scenario, the annual average contribution by RES to overall electricity generation is of 36% for the same period.

Council of Minister Resolution 63/2003, of 28 April, establishes targets for installed capacity of various RES to 2010 (Table 7).

The growth rate in installed capacity of renewable energy technologies has risen significantly in 2004 and 2005, particularly with regard to wind energy which contributed 816 GWh of electricity generation in 2004, up from 168 GWh in 2000 (an increase of 385.7%) and only 38 GWh in 1997. In the Azores, geothermic sources generated 84 GWh in 2004, while only 51 GWh in 1997.

Final energy consumption increased significantly (2.5% per year) from 1999 to 2004 mainly owing to the increase in consumption of crude oil products (1.7% oil; 24% natural gas) and of electricity (4.3% a year), as well as from Transport and Services sub-sectors. The rate of increase in oil consumption was higher than the total energy consumption growth rate, rising from 57.3% in 1990 to 58.5% in 2004.

[28] Hydroelectricity – domestic production; Other – biomass, waste and biogas; Fossil Fuel – coal, carbon oil and natural gas; Renewable – residential hydroelectricity and others

[29] Directive 2001/77/CE of the European Parliament and Council, of 27 September, on the promotion of the electricity produced from renewable energy sources in the international electricity market.

Table 7. Installed capacity (2001-2005) and indicative targets for 2010

Endogenous Resources	2001 (MW)	2002 (MW)	2003 (MW)	2004 (MW)	2005 (MW)	to be installed Capacity until 2010 (MW)
Wind	114	175	253	537	980	3750[30]
Small hydro	480	505	509	518	518	400
Biomass	8	8	8	12	12	150
Biomass with co-generation	344	372	352	357	357	
Biogas	1	1	1	7	7	50
Municipal Solid Waste	88	88	88	88	88	130
Wave						50
Photovoltaic	1	2	2	2	2	150
Hydro	3783	3783	3783	4043	4225	5000
Total	**4819**	**4933**	**4996**	**5564**	**6189**	**9680**[31]

Source: Council of Ministers Resolution 63/2003, of 28 April; DGGEb, 2005

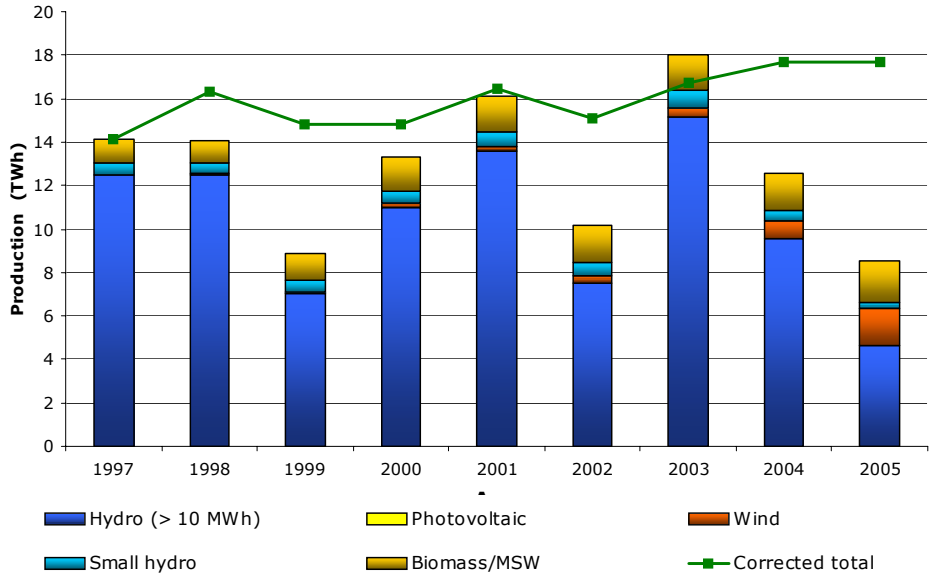

Figure 12. Electricity generation from RES (1997-2005)

Source: DGGEb, 2005

Trends observed in energy consumption sub-sectors (Figure 13) show changes in demand. The Industry sub-sector, which represented 33% of consumption in 1990, was responsible for 30% of the final energy consumption in 2004. Conversely, the Transport sub-sector represented in 2004 38% of the final energy consumption, while only 31% in 1990. Mobile sources, mainly road transport, are among the categories with fastest growth in final energy consumption. In 2004, the Residential and Service sub-sectors represented about 29% of total final energy consumption; Service sub-sector consumption grew 193% relative to 1990.

[30] Changed to 5100 MW by Council of Ministers Resolution 169/2005, of 24 October.

[31] Changed to 11 030 MW by Council of Ministers Resolution 169/2005, of 24 October.

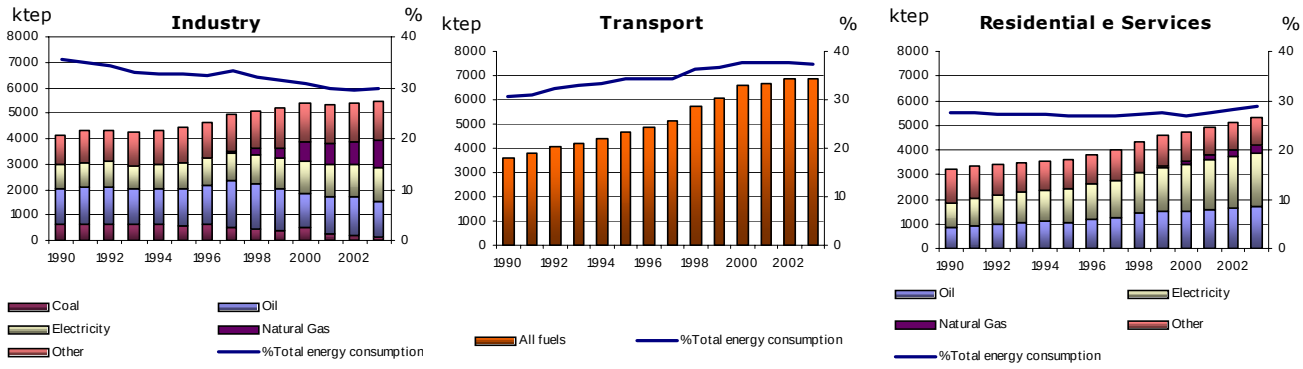

Figure 13. Final energy consumption by sector and fuel (1990-2004)

Source: IAb, 2006

Energy intensity is an indicator of the efficiency and sustainability of the economy, usually expressed in units of energy consumption (primary and final) per unit GDP. In 2004, the energy intensity recorded for primary energy consumption was 214.4 toe/GDP; for final energy consumption, the value was 159.8 toe/GDP. This represents an increase, relative to 2003, of 1.5% and 1.0%, respectively.

Table 8 shows the national energy balances for the years of 2002, 2003 and 2004.

Table 8. Energy balance (2002-2004)

Consumption (ktoe)	Year 2002	2003	%	2004	%
Primary energy	**26 333**	**25 737**	**-2.3**	**26 438**	**2.7**
National	3511	4236	20.6	3779	10.8
Electricity (Hydro, Wind and Geothermal)	750	1431	90.8	950	-33.6
Biogas	1	1		2	100.0
Firewood and waste	2760	2804	1.6	2827	0.8
Imported	22 822	21 501	-5.8	22 656	5.4
Coal	3500	3355	-4.1	3375	0.6
Oil	16 416	15 257	-7.1	15 411	1.0
Electricity (import balance)	163	240	47.2	557	132.1
Natural Gas	2743	2649	-3.4	3316	25.2
Losses and own consumption	5767	5075	-12.0	5262	3.7
Non-energy uses of oil	2170	2310	6.5	2437	5.5
Final Energy	**18 396**	**18 352**	**-0.2**	**18 739**	**2.1**
Coal	176	140	-20.5	88	-37.1
Oil	10 624	10 494	-1.2	10 650	1.5
Electricity	3566	3712	4.1	3842	3.5
Heat	1012	1051	3.9	1088	3.5
Natural Gas	1180	1267	7.4	1368	8.0
Firewood and waste	1838	1688	-8.2	1703	0.9

Source: DGGEa, 2005

1.6 Transport

Passenger transport, measured in passenger-kilometres (pkm) transported by the different modes available, shows a variety of trends, as a reflection of both supply and demand tendencies, throughout the period from 1990 to 2004.

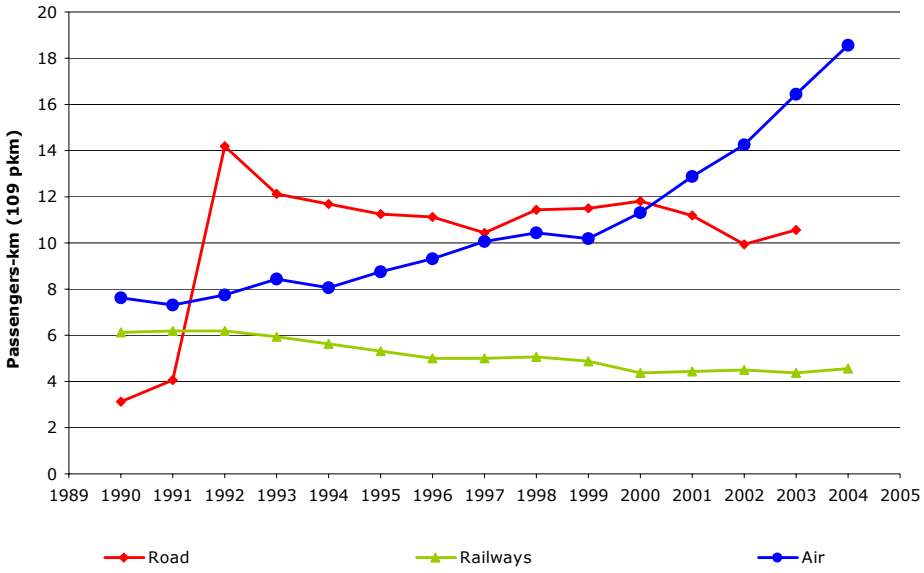

Figure 14. Trend in passenger transport, by mode (1990-2004)[32]

Source: IAa, 2006

Over the last decade, collective road transport oscillated between 10 and 12 thousand million pkm. Since 2001, air transport has outgrown road transport[33]. Railway transport, however, has had just over 4 thousand million pkm per year, considerably lower than other means and especially in comparison with air travel, which is also indicated for long-range transport.

The annual average variation in road transport from 1990 to 2004 surpassed that of other means, at almost 10%, as opposed to 6.6% for air transport and -2.1% for railway transport. Over the last decade, air travel has shown the strongest growth with variations of 15.3% and 13.2% in 2003 and 2004, respectively.

With regard to railway transport, Comboios de Portugal (CP) (Portuguese Railway Company) and Fertagus registered, over the past 5 years, 3.5 thousand million pkm annually. International transport (only by CP) has also decreased significantly, from around 90 million pkm in 2002 to almost 60 million pkm in 2004 (Figure 15). As for the subway network, the total length in Lisbon was of 48 km in 2004 (in 1990 there were only 24km) and 23 km in Oporto, a network initiated in 2003.

Figure 16 illustrates the trend in national and international passenger transport by air, registered in airports in the mainland, Madeira and the Azores.

Passenger transport by air has grown consistently, with a doubling of national and international air travel from 1990 to 2004; the total annual average variation was of 5.4% and 5.3%, respectively, for national and international transport during this period.

[32] Road transport figures refers only to the public fleet.

[33] Passenger-kilomenters for air transport refer exclusively to those recorded by TAP, SATA, Portugalia and Aerocondor.

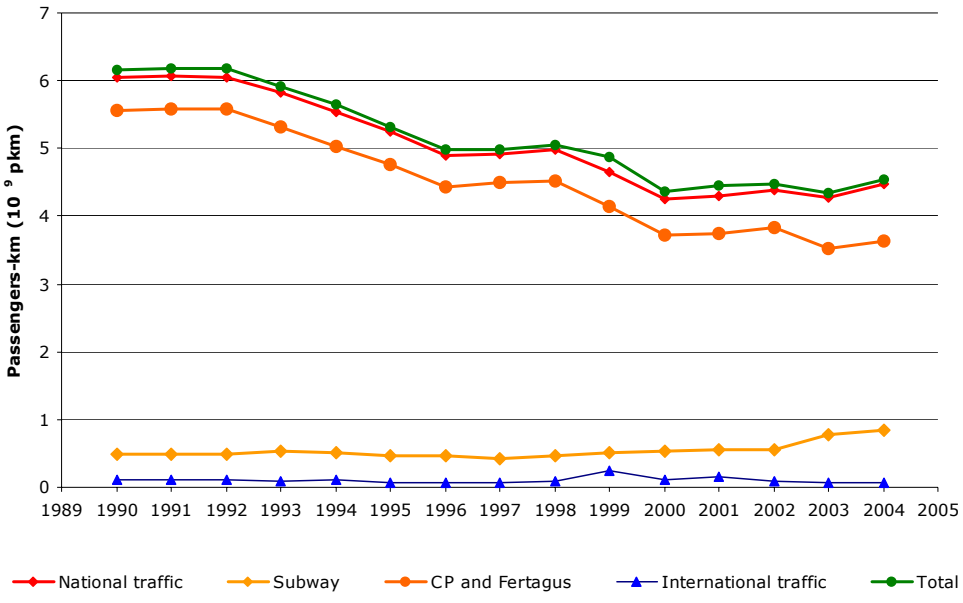

Figure 15. Trends in national and international rail transport

Source: IAa, 2006

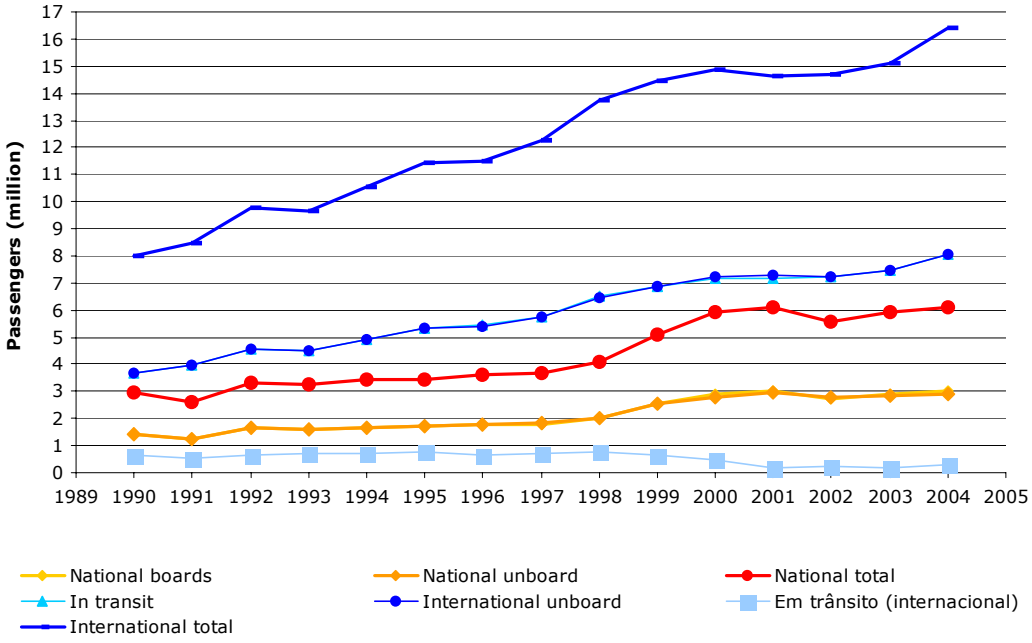

Figure 16. Trend in passenger transport by air (1990-2004)

Source: IAa, 2006

Table 9 presents the growth in the number of cars, the car fleet and passenger transport demand. It should be highlighted that the public intercity passenger transport represented 34% of the total transport on the road in 1994, falling to 22% in 2003.

Table 9. Trends in car ownership, car fleet and average passenger kilometres (1990, 1995, 2000-2003)

Year	1990	1995	2000	2001	2002	2003
New vehicles sold (number)	215 872	210 301	290 559	255 540	226 267	190 118
Car fleet (1000 passenger cars)	1617	2601	3614	3799	3949	4061
Average passenger kilometres (pkm/car)	13 557	12 117	11 023	10 385	10 633	10 452

Source: IAa, 2006

The transport of goods in tonnes-kilometres (tkm) (Figure 17) is overwhelmingly done by road transport (domestic transport, with an annual rate of growth of 5% since 1990), over railway (3.6% annual growth over the same period), and air transport.

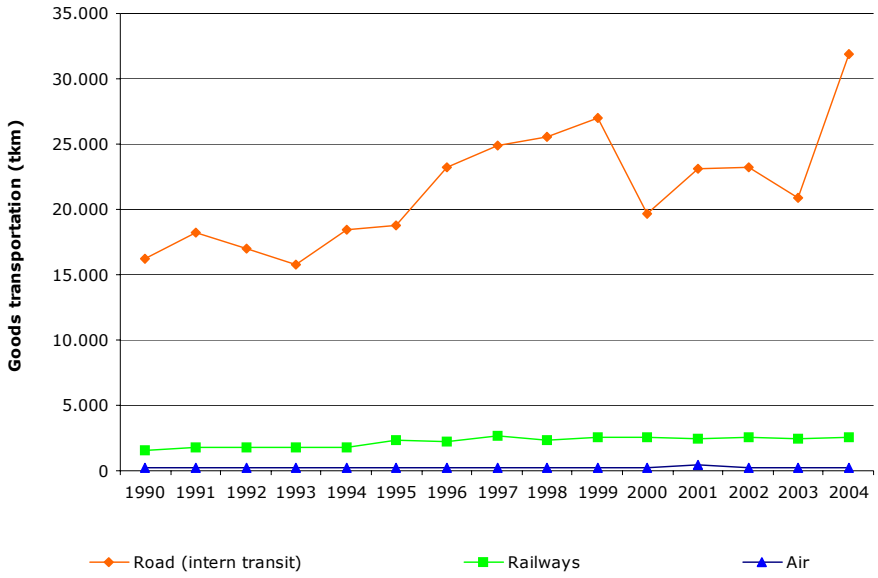

Figure 17. Trends in freight transport (tkm), by mode (1990-2004)

Source: IAa, 2006

1.7 Agriculture and Livestock

The Usable Agricultural Area (UAA) peaked in 2000, at almost 3900 thousand hectares and reached its minimum value in 1998, at about 3774 thousand hectares (Table 10).

Table 10. Trend in UAA (1998–2004)

	Year						
	1998	1999	2000	2001	2002	2003	2004
UAA (10^3 ha)	3774	3886	3868	3795	3846	3812	3817

Source: INEc, 2005

The crops with most significant agricultural production are cereals (excluding rice), potato and industrial crops. Rice production, an important source of methane, was at its lowest in 1993 (Figure 18).

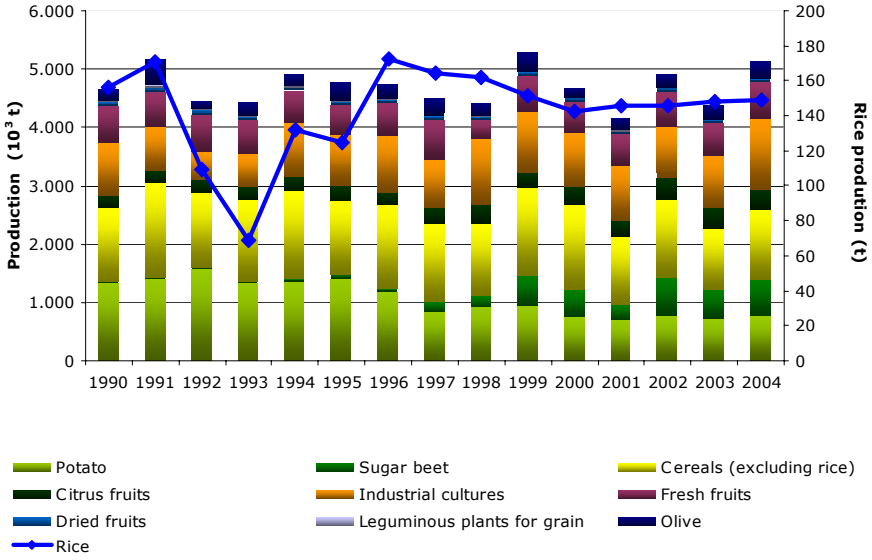

Figure 18. Trend in the production of main crops (1990-2004)[34]

Source: INEd, 2005

Livestock production has been steady for the various breeds except pig, which reached a peak in 2004, influencing the total production (4.8 million heads) (Figure 19).

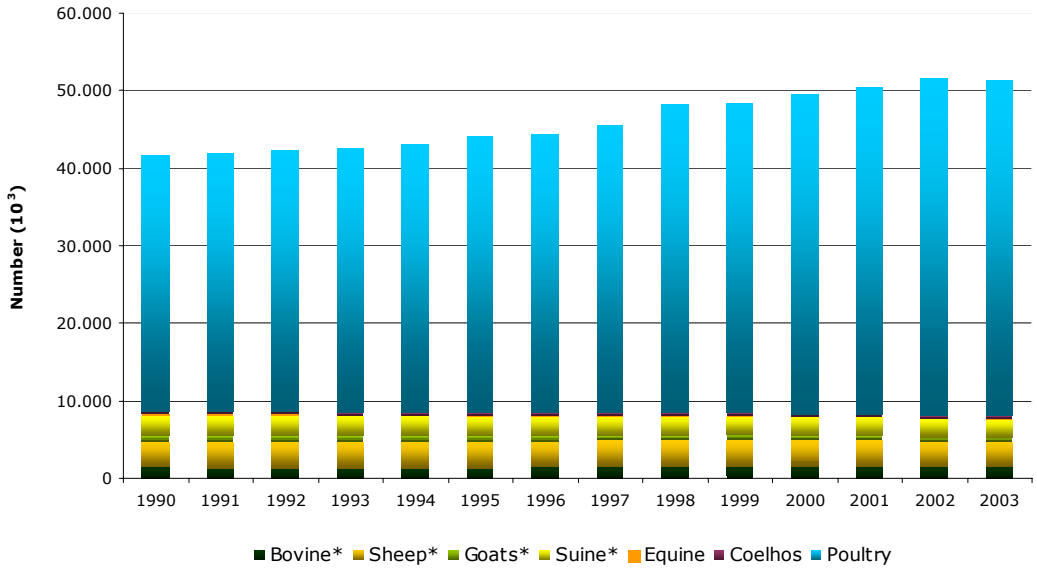

Figure 19. Trend in livestock numbers by breed (1990–2003)[35]

Source: IAb and INEd, 2005

[34] Cereals: Wheat, Rye, Barley, Oats, Maize and Triticale; Industrial Crops: Tomato, Hop, Sunflower and Tobacco; Fresh Fruit: Plums, Cherries, Damascus, Persimmon, Fig, Morello Cherry, Kiwi, Apple, Quince, Medlar, Pear, Peach, Pomegranate, Grape, Banana and Pineapple; Dried Fruits: Almond, Hazelnut, Chestnut and Walnut.

[35] The classes marked with * use three year moving averages.

1.8 Land Use and Land Use Change

According to the Image and CORINE Land Cover 2000 (I&CLC2000) Project results for 2000, 72% of mainland Portugal was covered by forest and agriculture and 14% by mixed areas of agriculture and natural areas. The artificial territories covered only 3% of the mainland, and natural vegetation 9%.

Among the artificial territories, discontinuous urban occupation is dominant, occupying approximately 70% of the area of each class. Industry, commerce and infrastructures are the second most significant occupation (12%), followed by built up areas (6%) and mines and quarries (6%).

Within the 6 occupational classes assessed, between 1985 and 2000, the total area land cover change in mainland Portugal was of 371 000 hectares, which corresponds to 4% of the country.

The following observations can be made relative to the period 1985 - 2000:

- artificial territory is the only class with no significant transitions into others within the assessment period, showing the second largest growth in area in mainland Portugal (70 000 hectares);
- natural vegetation is the class which lost most area (101 000 hectares) and the one that least expanded into areas previously occupied by other classes (26 000 hectares);
- even though agricultural areas expanded into new areas (44 000 hectares), 79 000 hectares ceased being used for agricultural purposes, resulting in a net decrease of 35 000 hectares;
- 71 000 hectares of forest area were lost, though 165 000 hectares were converted into forests, resulting in a net growth of 94 000 hectares;
- both forests and artificial territories registered net increases in area;
- artificial territory is the land use type which has most changed relative to 1985, gaining 42% in area;
- natural vegetation decreased 9% relative to 1985;
- the variation in land use for the remaining classes was significantly lower. Agriculture lost 1%, agriculture with natural spaces lost 4% and forest gained 3%.

The most important changes among classes were from natural vegetation to forest (72 000 hectares), from agriculture to artificial surfaces (33 000 hectares) and from agriculture with natural areas to forest (32 000 hectares) (Figure 21).

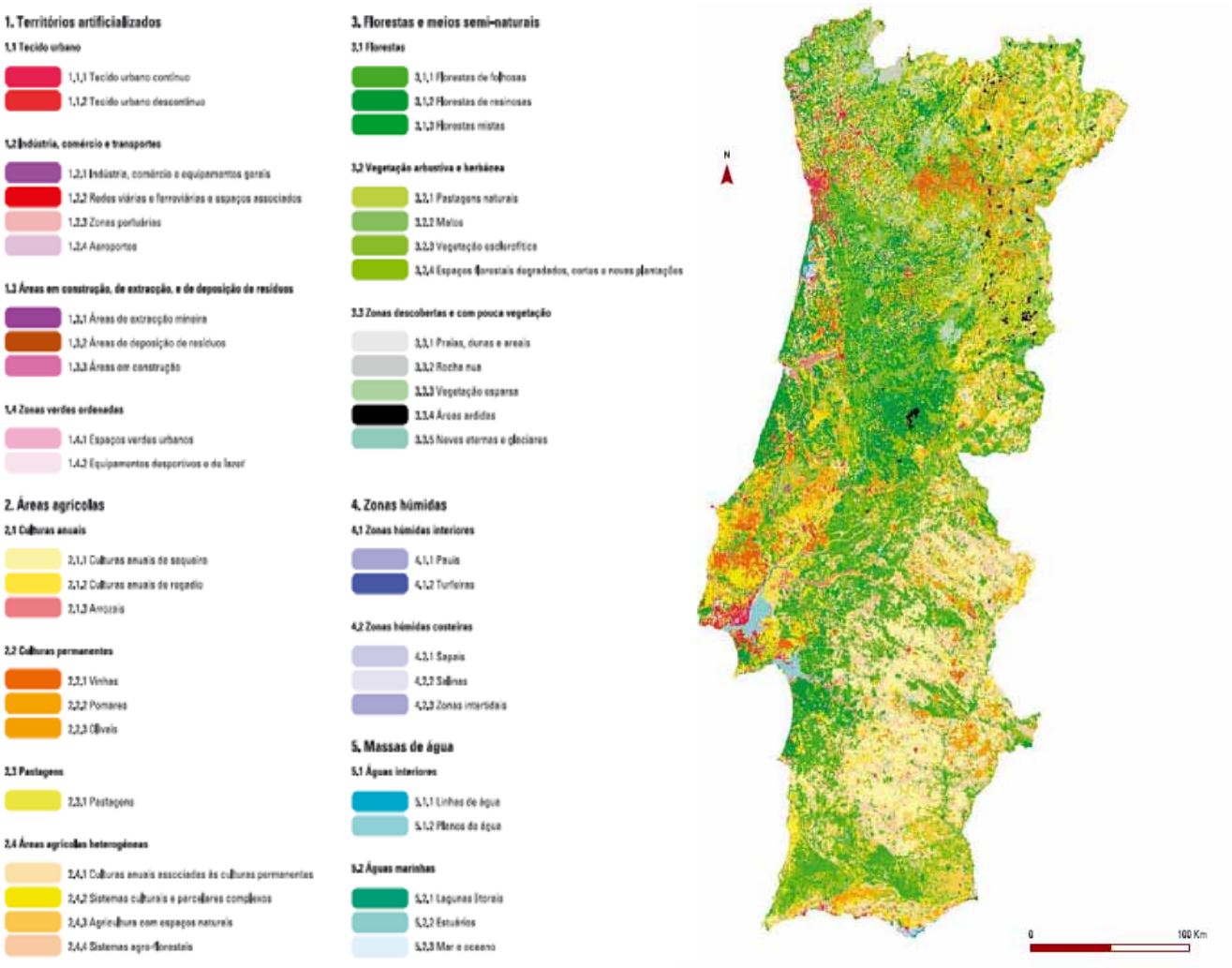

Figure 20. Geographical distribution of the main land use classes in the year 2000
Source: IAc, 2005

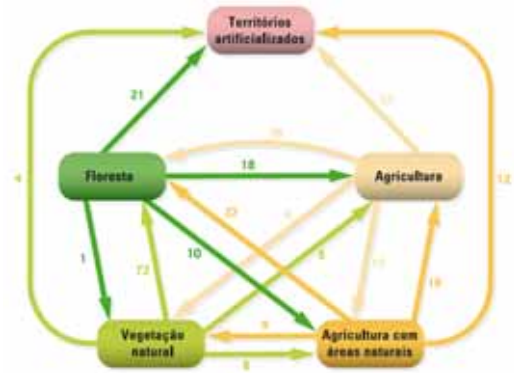

Figure 21. Land use transitions between classes from 1985 to 2000 (thousand hectares)
Source: IAc, 2005

1.9 Forestry

Government policy refers to forests as an integrated component in the fight against climate change and in matters relating to sustainable development, confirming that which is expressed in the Framework Law for Forest Policy (Law 33/96, of 17 August) and which was proposed by the Sustainable Development Plan for Portuguese Forests (Council of Ministers Resolution 27/99, of 8 April).

According to the third revision of the 1995 National Forest Inventory (IFN), conducted in 1998, mainland Portugal had a forested area of 3.3 million hectares in 1995, corresponding to more than 37% of the overall land cover.

According to the most recent IFN, almost 9 million m^3 of wood are taken from the forest annually, as well as 3 million m^3 of softwoods and 6 million m^3 of hardwoods. Cork plantations produce an average of 120 000 tonnes of cork.

Forestry resources play an important role in the national economy. Forestry is mainly an export sector, with a net commercial balance exceeding 1 thousand million Euros in 2003. Forest products (softwood items, timber, cork oak, pulp, paper and wooden furniture) represent approximately 10% of the total Portuguese exports, and worth over 2.7 thousand million Euros with 5 million tonnes of product in 2004.

Portugal imports raw forest materials for processing in the country, both for domestic consumption and for export.

Table 11. Distribution of forest stands, pure and mixed, in mainland Portugal

Forest Species	1980/1990		1995/1998	
	Surface (1000 ha)	Land Cover (%)	Surface (1000 ha)	Land Cover (%)
Pinus pinaster Aiton	1292.9	40	1026.4	31
Pinus pinea L.	34.7	1	78.6	2
Other conifers	34.7	1	44.5	1
Quercus suber L.	656.6	21	719.4	22
Quercus rotundifolia Lambert	535.9	17	463.8	14
Other oaks	70.5	2	134.1	4
Eucalyptus globulus Labillardiére	438.0	14	696.3	21
Castanea sativa L.	29.3	1	40.3	1
Other leafy varieties	65.7	2	120.5	4
Other mixed varieties	29.0	1		
Green areas	5.9			
Total	3193.2	100	3323.9	100

Source: DGRF, 2005

Portuguese forests have undergone significant changes in the past decade, both as a result of the abandonment of agriculture and the consequent land use by forestry, as well as forest fires that have reached huge proportions and led to the declaring of a state of emergency within some regions of the country. Consequently, the Government has been deliberating about the sector, which is currently under restructuring. Following the extreme situation of 2003, the following year saw a slight diminishing of the number of forest fires, with a considerable reduction of the total burnt area (from 425 000 hectares to 129 000 hectares) (Figure 22).

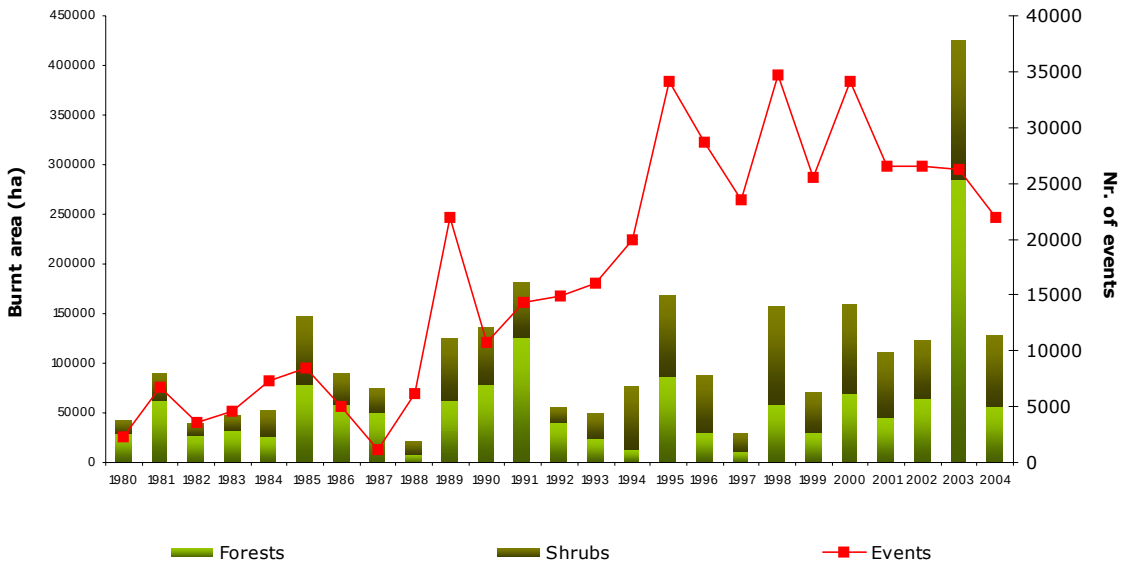

Figure 22. Fires affecting forests and shrubs, burnt area and number of fire events (1990-2004)
Source: DGRF, 2005

A new National Forest Inventory, which will be annually updated, is under development. The 25 year National Plan of Forest Fire Protection[36] (PNDFCI), defines a strategy for fostering the active management of the forest, creating the necessary conditions for the progressive reduction in forest fires. The Regional Plans for Forest Regulation (RPFRs) are now concluded and in the approval stage. The National Strategy for the Forests is under public consultation. It will set objectives and goals for the sector and will implement the Forest Intervention Areas (FIA), with the objective of overcoming problems connected to the excessive fragmentation of property so as to ensure, in specific areas, both forest protection and sustainable forest management. This will, in turn, ensure in a step-by-step process, the protection of continuous forest areas, particularly through the establishment and maintenance of a delimited areas and prevention infrastructures as set by the PNDFCI.

Furthermore, several relevant legal instruments are under discussion, most markedly that pertaining to the infraction regime applicable within the domain of the Portuguese National Plan of Forest Fire Protection and the new regulations for the Forest Fire Fighters. The Council of Ministers Resolution 5/2006, of 18 January, approved the Strategic Guidelines for the Recovery of Burnt Areas, established by the National Council for Reforestation (CNR) that was created after the major fires of 2003.

Technical and forestry parameters for energy recovery from forest biomass waste are also being considered.

1.10 Waste

The production of Municipal Solid Waste (MSW) in mainland Portugal increased, in 2004, to 4.4 million tonnes, i.e. about 1.2 kg per inhabitant per day[37]. Most of the production of MSW occurs in Lisbon and Tagus Valley and in the North, due to the higher population densities and the concentration of economic activities. The production of MSW has generally been increasing since 1990, though at a decreasing rate in recent years (Figure 23).

[36] Council of Ministers Resolution 65/2006, of 26 May.

[37] 2002 and 2003 values consider population figures under the 2001 census; 2004 the values use Provisional Estimates of the Resident Population in 31/12/2002, based on the final results of the 2001 Census, and adjusted for the coverage ratio (INE).

All of the population is served by waste collection systems and the whole country is covered by inter/multi-municipal treatment and recovery systems. Waste collection and recovery will continue to be a priority area, requiring not only the reinforcement of existing infrastructure, but also the implementation of new systems for the collection of biodegradable urban waste, recycling and energy recovery from waste, so as to reduce the amount of waste to landfill.

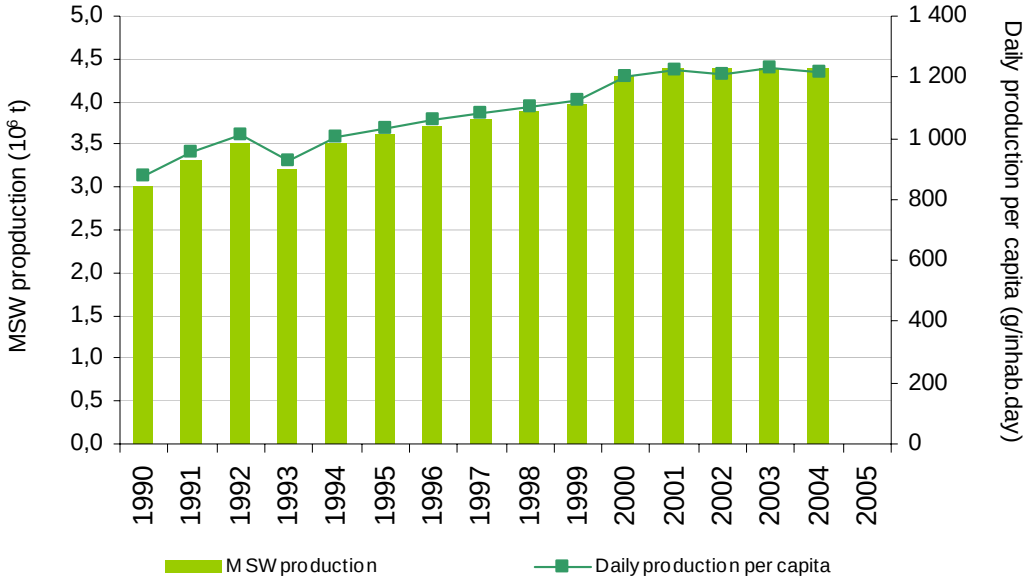

Figure 23. MSW production, total and per capita/day (1990–2004)

Source: INRb, 2005

In 2004, approximately 66% of MSW produced was landfilled, 20% incinerated with energy recovery, 7% composted and 7% selectively collected for recycling (Figure 24 and Figure 25).

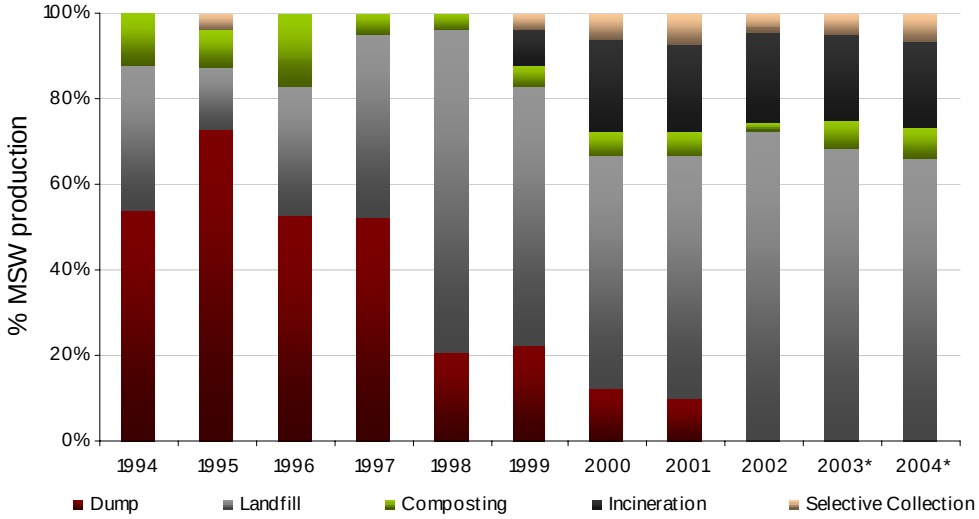

Figure 24. Share of MSW by final destination in mainland Portugal (1994-2004)[38]

Source: INRb, 2005

[38] Selective collection includes collection from recycling stations, door-to-door, eco-centres and materials rejected for composting which are redirected for recycling which represented, in 2003 and 2004, 619 tonnes and 1227 tonnes, respectively.

Most of the waste from the Autonomous Region of the Azores is deposited in controlled landfills, though there has been an increase in selectively collected waste. In the Autonomous Region of Madeira there has been a decrease in the amount of MSW sent to landfill, since 2002, as a consequence of the increase in incineration. Composting has also increased, though from 2003 to the first semester of 2004 the composting unit was under extension and remodelling works.

The generation of packaging waste has increased since 1998, as has the amount of used packaging collected and sent either for recycling or energy recovery (Figure 26)[39].

About 13 million tonnes of Industrial Waste (IW) was produced in 2002, of which 187 000 tonnes, approximately 1.4%, were labelled as Hazardous Industrial Waste (HIW).

HIW has remained a consistent component of the total production of industrial waste (Figure 27). Figure 28 shows industrial waste production by activity; Figure 29 shows their corresponding destinations.

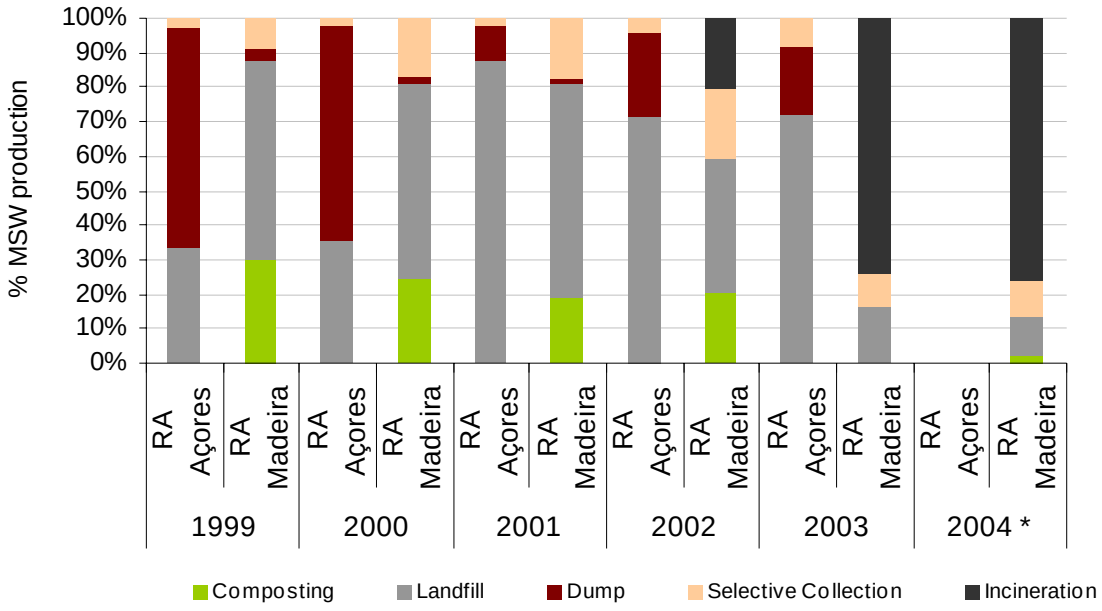

Figure 25. Share of MSW by final destination in the Autonomous Regions (1999-2004)[40]
Source: INRb, 2005

[39] There is no data for wood packaging in 2002 and 2003.

[40] There is no data for the Autonomous Region of the Azores in 2004 as MSW registries were not yet concluded.

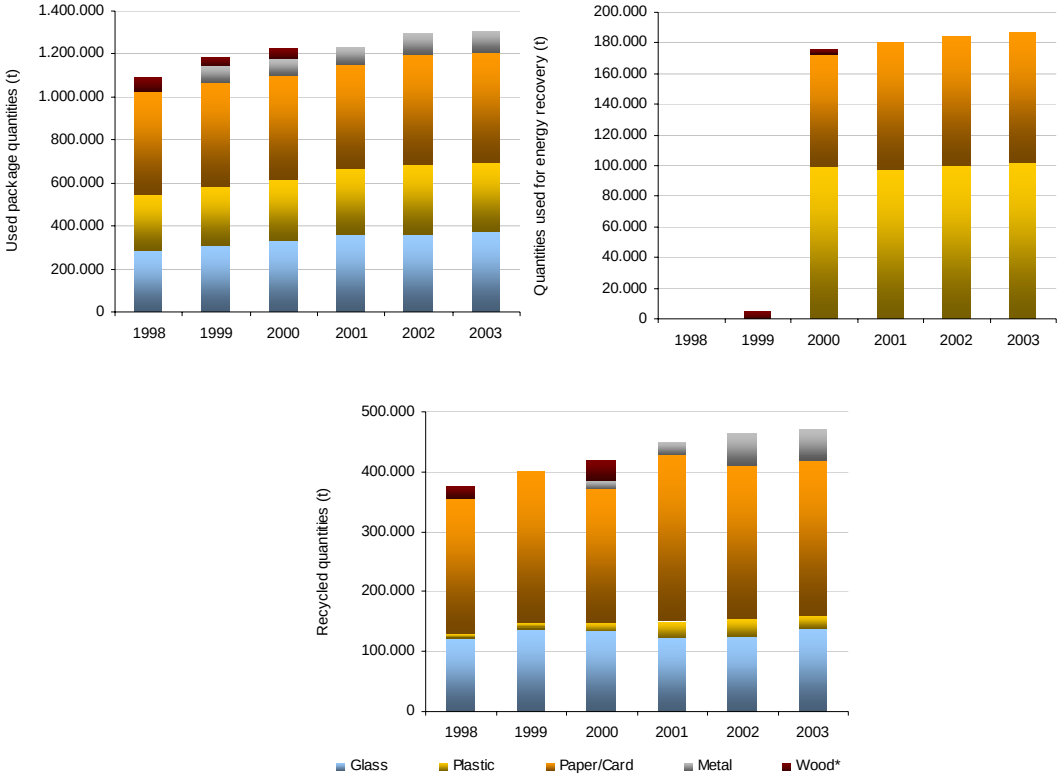

Figure 26. Production of packaging waste and amounts sent for recycling and energy recovery (1998-2003)

Source: INRb, 2005

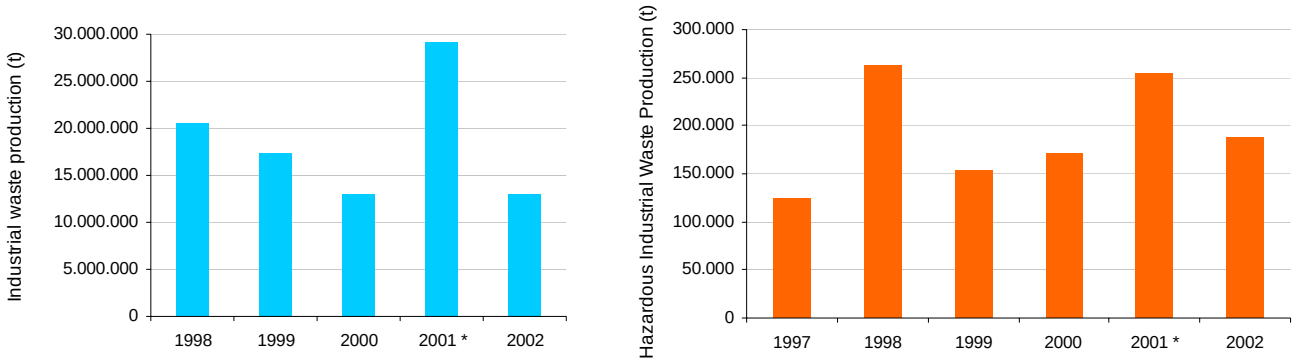

Figure 27. Production of Industrial and Hazardous Industrial Waste (1997-2002)

Source: INRb, 2005[41]

[41] Data referring to 2001 taken from the Study of Universities– Inventory of the production of industrial waste in the mainland - INPRI (extrapolation for the whole country of the values collected from the sample).

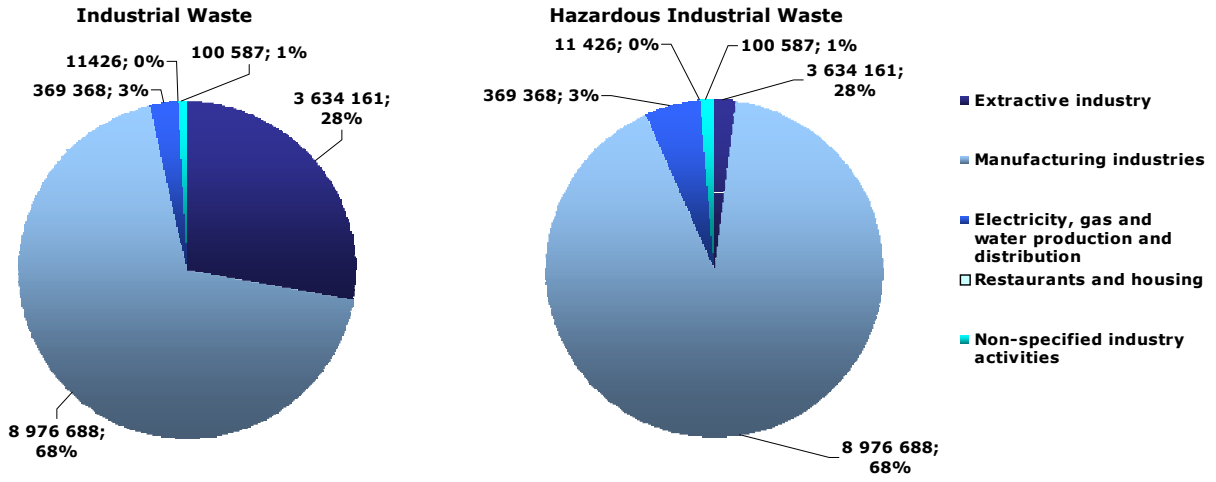

Figure 28. Production of Industrial and Hazardous Industrial Waste (HIW), by sector of activity, in 2002[42]
Source: INRa, 2005

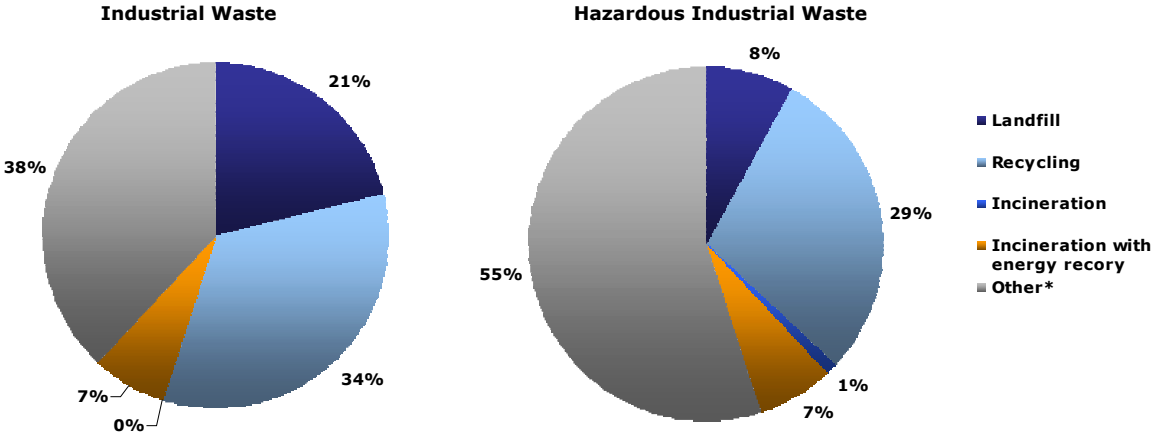

Figure 29. Quantities of industrial waste and hazardous industrial waste (HIW), by final destination, in 2002[43]

Source: INRa, 2005

In 2004, the Lipor incineration station produced 477 180 MWh of energy, while the Sao Joao da Talha (Valorsul) station produced 48 176 MWh.

[42] In the Autonomous Region of Madeira it was not possible to specify the industrial waste produced according to the industrial activities. This way the values referring to this Region are included in the category of "Non-specified Industrial Activities".

[43] The category "Others" comprises the remaining operations, except for the land-fill, recycling, incineration and incineration with energy recovering, as well as residues whose destination was impossible to declare.

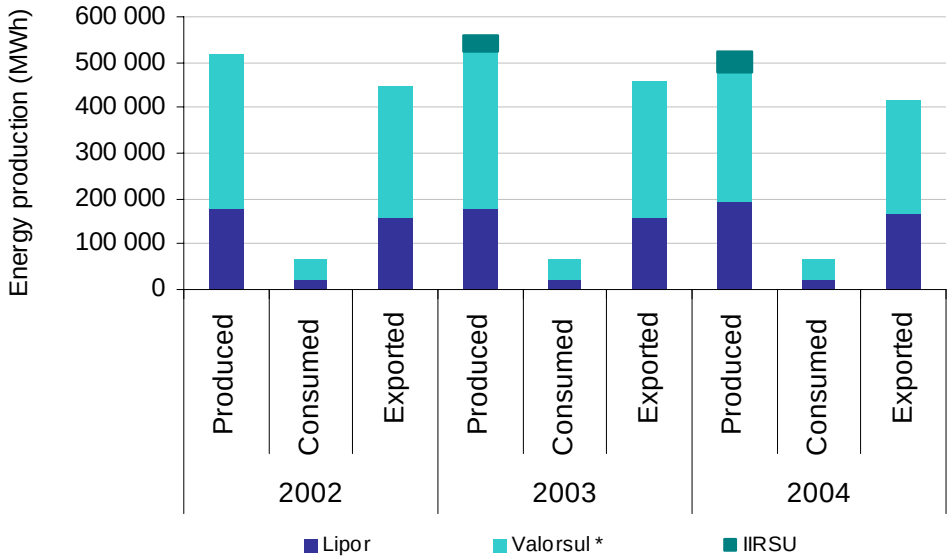

Figure 30. Energy produced, consumed and exported by the MSW incineration units, in mainland Portugal and Madeira Islands (2002-2004)

Source: INRb, 2005

In the autonomous Region of Madeira, MSW is burnt at the Municipal Waste Incinerator of the Waste Treatment Facility of Meia Serra (IIRSU). The generation of electricity from waste incineration started in an experimental phase in 2002. In 2004 approximately 48 176 MWh were produced.

2 Information on the National Greenhouse Gases Inventory System

2.1 National System for the Estimation of Emissions by Sources and Removals by Sinks of Air Pollutants

The National Inventory System of Emissions by Sources and Removals by Sinks of Air Pollutants - (SNIERPA) contains a set of legal, institutional and procedural arrangements that aim at ensuring the accurate estimation of emissions by sources and removals by sinks of air pollutants, as well as the communication and archiving of all relevant information.

The implementation of the SNIERPA is a response to two commitments made at the international and EC levels:

- in the context of the Convention and of the Kyoto Protocol, the Decision 20/CP.7 - Guidelines for national systems for the estimation of anthropogenic greenhouse gas emissions by sources and removals by sinks - under Article 5(1) of the Kyoto Protocol[44], which mandates the implementation of a national system until the 1st January 2007;
- at the EC level, Decision 280/2004/EC of the European Parliament and of the Council, of 11 February, on the creation of a mechanism for monitoring EC greenhouse gases (GHG) emissions and for implementing the Kyoto Protocol, which anticipates the implementation of a national system by 31st December 2005.

For the sake of efficiency, the Portuguese national system, which obligations include only emissions of GHG not covered by the Montreal Protocol, is broadened over a wider group of air pollutants, allowing for improvements in information quality, as well as an optimisation of human and material resources applied to the preparation of the inventory. At a first stage, it includes the acidifying and eutrophication gases, with the inclusion of particulates, heavy metals and persistent organic pollutants expected at a later stage.

The SNIERPA is composed of three technical instruments:

- a Methodological Development Programme (PDM);
- a Quality Assurance and Control System (QA/QC); and
- an integrated information technology (IT) system for SNIERPA's management (SIGA).

2.1.1 General Description on the National System

The principal objective of the system is to prepare in a timely fashion the inventory of air pollutants (INERPA), in accordance with the directives defined at international and EC levels, in order to make easier and more cost-effective the tasks of inventory planning, implementation and management.

The system was established through Council of Ministers Resolution 68/2005, of 17 March, which defines the entities relevant for its implementation, based on the principle of institutional cooperation. This clear allocation of responsibilities is essential to ensure the inventory takes place within the defined deadlines.

[44] FCCC/CP/2001/13/Add.3

Three bodies are established with differentiated responsibilities. These are:

- the Responsible Body[45] appointed is the Institute for the Environment (IA), being responsible for: overall coordination and updating of the National Inventory of Emissions by Sources and Removals by Sinks of Air Pollutants (INERPA); the inventory's approval, after consulting the Focal Points and the involved entities; and its submission to EC and international bodies to which Portugal is associated, in the several communication and information formats, thus ensuring compliance with the adopted requirements and directives;
- the sectoral Focal Points work with IA in the preparation of INERPA, and are responsible for fostering intra and inter-sectoral cooperation to ensure a more efficient use of resources; and
- the involved entities are public or private bodies which generate or hold information which is relevant to the INERPA, and which actions are subordinate to the Focal Points or directly to the Responsible Body.

Table 12 lists the main focal points and involved entities, by sector of activity.

Table 12. Bodies that contribute information relevant to the preparation of the INIERPA

Sector of Activity	Focal Point	Involved Entities
National Statistics[46]	National Statistics Institute	
Environment Statistics[47]	Institute for the Environment	
Energy Statistics	Directorate-General for Geology and Energy	
Energy:		
Industry and civil construction.....	Directorate-General for the Enterprise	
Transport.....	Environmental Auditor of the Ministry of Public Works, Transport and Communications	
Road.....	Directorate-General for Driver Licensing	Studies and Planning Office of the Institute of Portugal´s Roads, Diectorate-General of Land and Water Transport
Rail.....	.....	Studies and Planning Office, National Institute of Rail Transport, "*Comboios de Portugal*", National Railway Network
Aviation.....	.....	Studies and Planning Office, National Civil Aviation Institute
Sea.....	.....	Studies and Planning Office, Port and Sea Transport Institute, Port Administration
Fugitive Emissions from Fossil Fuels.....	Directorate General for Geology and Energy	

[45] Institute for the Environment, Rua da Murgueira, 9/9A, 2610-124 Amadora; Teresa Costa Pereira, teresa.costa-pereira@iambiente.pt

[46] Transversal to all sectors of activity.

[47] Relevant data obtained from the implementation of the Directives on Large Combustion Plants and on Integrated Pollution Prevention and Control.

Sector of Activity	Focal Point	Involved Entities
Industrial Processes	Directorate-General for Enterprise	
Solvent Use and Other Products.....	Directorate-General for Enterprise	
Agriculture	Environmental Auditor of the Ministry for Agriculture, Fisheries and Forestry	Zootechnical Station Rebelo da Silva Agro-Chemical Laboratory
Forestry and Land Use Change		
Forestry	Drectorate-General of Forestry	
Land Use Change.....	Portuguese Geographical Institute	
Waste		
Disposal/incineration of waste	Institute for Waste Management	
Wastewater...	Water Institute	Drectorate-General for Health

2.1.2 Planning and Quality

Two instruments of the SNIERPA ensure technical and methodological accuracy, completeness and reliability of the inventory: the Methodological Development Programme (PDM) and the Quality Assurance and Control System (QA/QC).

The PDM aims at identifying and defining a calendar for the application of methodological developments to the emissions estimates from the different categories of sources and sinks defined in the INERPA, by engaging experts in the inventory preparation process. It is a fundamental instrument in the planning of activities with all relevant entities.

The objective of the QA/QC System is to provide a set of verification (basic and technical) procedures to ensure the accuracy, completeness, transparency, reliability and representativeness of the emissions inventory. The system includes an application programme and a Manual of Procedures for QA/QC.

The results achieved with the application of the QA/QC system provide the main input in the preparation of the PDM. QA/QC procedures identify the areas of the INERPA with the most significant problems. The PDM allocates priorities to the resolution of problems identified through the QA/QC.

The complete implementation of these two instruments is important in ensuring that the national system is effectively implemented in the context of the Kyoto Protocol.

2.1.3 Management

SNIERPA's management includes tasks aimed at ensuring the application of these instruments, both in terms of annual time planning and achievement of medium and long term objectives.

An Integrated IT System for the Management of SNIERPA (SIGA) is currently being developed, with the view of endowing the national system with the capacity to archive and manage all the information necessary for the preparation of INERPA, including activity data, intermediate calculation parameters and emission factors, justification for the use of a given methodology, deadlines for submission of data and the identification of contacts for each body and Focal Point.

SIGA will be the reference for all involved in the preparation of INERPA, further to its role in information dissemination to the wider public. It will also perform simple functions such as sending reminders to the Focal Points and to the involved entities on upcoming deadlines for information's submission. Figure 31 represents the connections between the various components of SNIERPA.

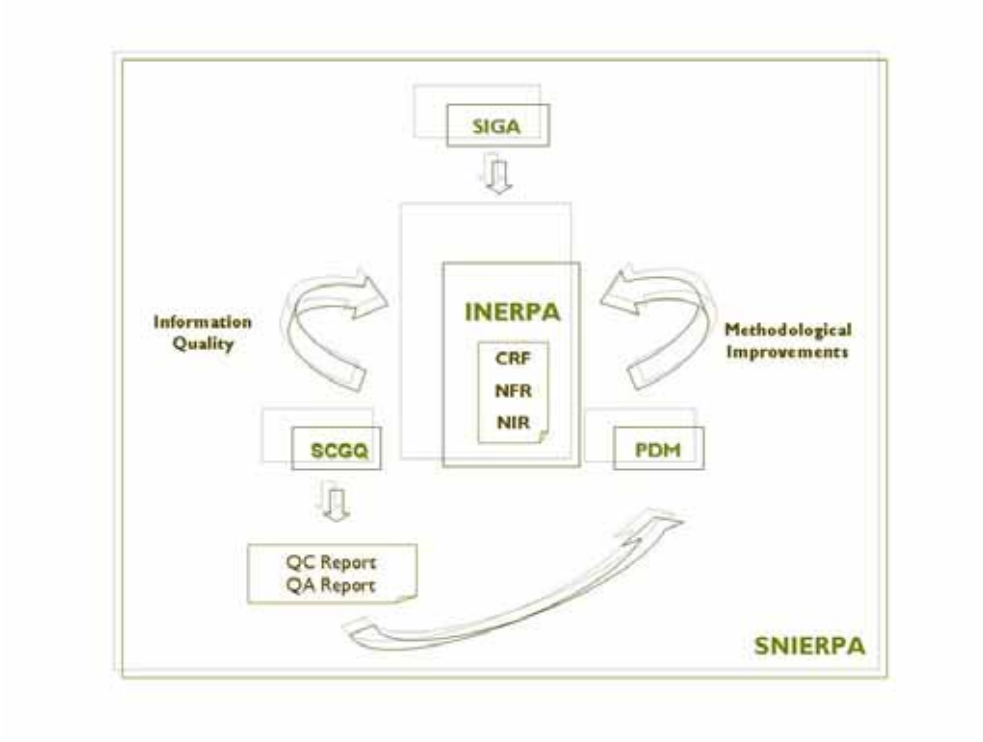

Figure 31. Connections between the various elements of SNIERPA

Source: IAb, 2005

2.2 Methodologies, Quality and Uncertainties

The inventory was calculated in accordance with internationally accepted recommendations and guidelines[48]. Key sources analysis of the 2006 inventory (period from 1990 to 2004) was based on a tier 1 methodology. This consists of a "level analysis" for each source (based on the emissions values) and a "trend analysis" (based on the time series trend for the period 1990-2004), enhanced by a set of qualitative criteria to identify additional uncertain or incomplete sources.

The QA/QC System consists of the Programme of Quality Control and Assurance and the Manual of Quality Control and Assurance. The first defines the calendar for the application of general procedures (QC1), the specific procedures for each source sub-category (QC2) and the quality assurance procedures (QA) listed in the manual. The various procedures listed on the manual have been drawn on the basis of the IPCC Good Practice Guide (GPG) guidelines and adapted to the specific characteristics of the Portuguese INERPA preparation.

[48] UNFCCC Reporting Guidelines on Annual Inventories, Intergovernmental Panel on Climate Change; The Revised 1996 Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas (IPCC, 1997); Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000); Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC, 2003).

QC1 procedures are organized by checklists which include: basic checks on the accuracy of data acquisition processes (e.g. transcription errors); checks on calculation procedures, data and parameters; cross-checking for consistency of data which is common across categories; verification of the National Inventory Report (NIR) and the Common Report Format (CRF) tables. Documentation and archiving procedures enable data handling for inventory recalculation.

QC2 procedures include technical verifications of the emissions factors and the activity data, and comparisons of the results obtained from different sources.

Finally, QA consists of a system of procedures to review parameters, activity data and emissions factors, as well as to validate the methodologies applied; this system is run by agents not directly involved in the development and compilation of INERPA.

Formal reports are produced following QC and QA procedures and made available for consultation.

The 2006 INERPA's submission, in the context of SNIERPA's implementation, was submitted to QC1, including the CRF tables and the NIR, and QC2 procedures (which results are included in the NIR). The QA procedures were carried out in the frame of the PDM.

The main objective of the uncertainty assessment is to aid the prioritisation of efforts towards improving the accuracy of future inventories and methodologies. The level of uncertainty in the emissions estimates are due to the natural variability of some emissions processes, incomplete knowledge of emissions sources and their identification, the errors and gaps in data collection and statistical information, incorrect choice and calculation of emissions factors and parameters due to monitoring data errors, and expert studies and assessments.

A Tier 1 methodology was used to estimate total inventory uncertainty for each year, as well as the uncertainty in the emissions trends. This method of analysis attaches uncertainty values to the activity data and the emissions factors, for each pollutant, and uses error propagation rules to combine the uncertainty estimates of each of the individual sources in the overall value. According to the IPCC's GPG, uncertainty considerations for the Global Warming Potential are not considered.

The uncertainty analysis was applied CO_2, CH_4, N_2O, HFC and SF_6 emissions, and considers emissions in terms of CO_2 equivalents. The uncertainty of total emissions sources has been determined, except for the Land Use, Land Use Change and Forestry (LULUCF) sector.

The uncertainty values are defined within a 95% confidence interval; values for activity data, emissions factors and emissions estimates have a 95% probability of confinement within confidence limits.

2.3 Emissions Trends: 1990-2004

In 2004, total GHG emissions estimates, without Land Use, Land Use Change and Forestry (LULUCF), accounted for 84.6 Mt CO_2e, an increase of approximately 41% relative to 1990. In accordance with the EU Burden Sharing Agreement[49], Portugal has committed to limit its emissions growth to 27% relative to 1990 levels. Comparing the growth observed between 1990 and 2004 with the linear trend for the period 1990-2010, GHG emissions in Portugal were, by 2004, roughly 22% above target (Figure 32). Emissions increased at about 3% per annum throughout the period 1990-2004.

[49] Council Decision 2002/358/EC of 25 April 2002 concerning the approval, on behalf of the European Community, of the Kyoto Protocol to the United Nations Framework Convention on Climate Change and the joint fulfilment of commitments thereunder

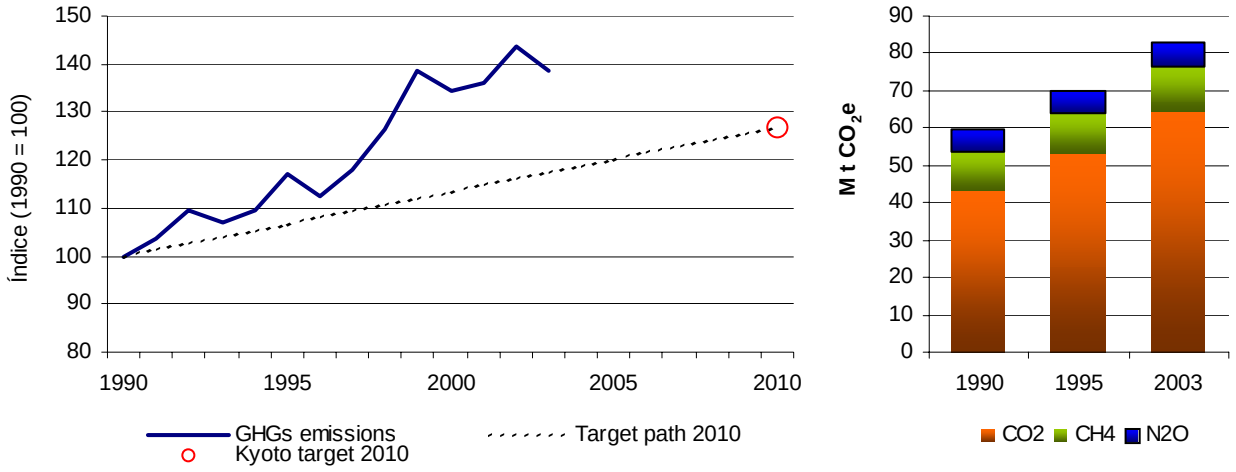

Figure 32. GHG emissions without sector 5 of IPCC (1990-2004)

Source: IAb, 2006

The most significant source of GHG in Portugal is associated to the Energy sector and is directly related to the burning of fossil fuels. With 77% of the total 2004 emissions weighed by GWP[50], CO_2 is the most abundantly emitted GHG, 89.6% of which accrues to the Energy sector.

2.3.1 Analysis by Sector

In accordance with Convention reporting guidelines, emissions estimates are grouped in six main sectors: Energy, Industrial Processes, Solvent Use, Agriculture, Land Use, Land Use Change and Forestry (LULUCF) and Waste.

All sectors have registered emissions increase in the reference period (Figure 33). For the LULUCF sector, positive values infer that the sector is a net emitter while negative values reflect sink capacity. Thus, LULUCF sector estimates indicate it is a net emitter in 1990 (3.2 Mt CO_2e) and a sink in 2004 (removal of 2.7 Mt CO_2e).

The Energy sector is responsible for the most significant share of emissions, representing about 72% of the emissions total in 2004, a 51% increase since 1990. Within this sector, the Public Electricity and Heat Production and Transports sub-sectors are the most relevant, accounting for 25% and 24%, respectively, of the total national emissions in 2004. This demonstrates the extent of Portugal's dependency on fossil fuels for power generation and, in particular, for transport. This dependency is still increasing due to growth in electricity demand by the Residential and Services sub-sector as well as to increased mobility needs, with total final energy consumption increasing by about 58% between 1990 and 2003.

The pattern of final energy consumption is reflected on GHG emissions (Figure 34). Driven by an increase in household income and investments in road infra-structure during the 1990s, there was an expansion observed in the vehicle fleet (particularly with more powerful engines) and total road transport, leading emissions from the Transport sub-sector to increase about 99% from 1990 to 2004. The increase in road traffic also has an indirect effect in increasing emissions from storage, handling and distribution of fossil fuels. Emissions from the Industry and Construction sub-sectors have increased at the lower rate of 17% from 1990 to 2004, while those from the Residential and Services sub-sector grew by approximately 59% relative to 1990.

[50] Global Warming Potential.

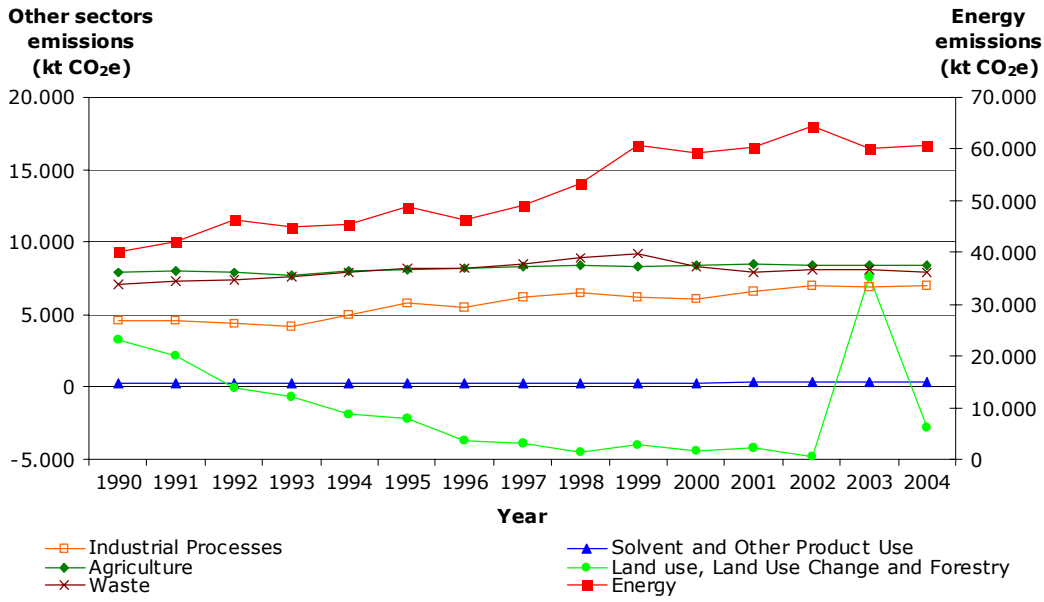

Figure 33. GHG emissions and removals (1990–2004)

Source: IAb, 2006

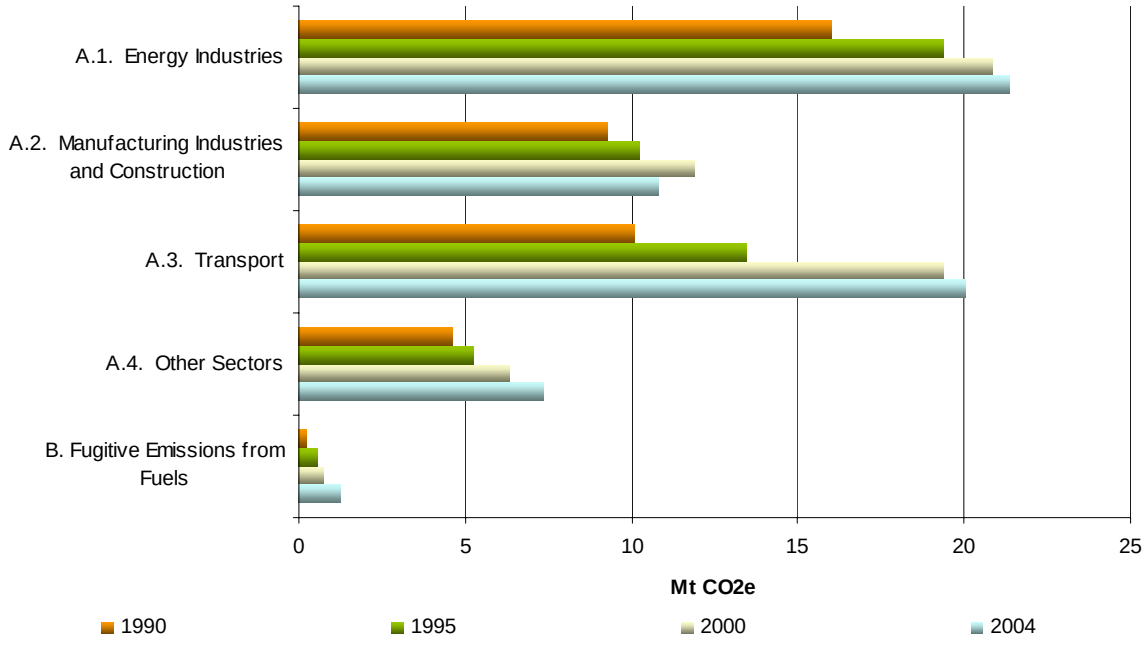

Figure 34. GHG emissions in the Energy sector

Source: IAb, 2006

GHG emissions from Agriculture, Waste and Industrial Processes sectors represented in 2004 about 10%, 9% and 8%, respectively, of the national emissions (excluding the LULUCF sector). Despite the increase in absolute emissions from the Agriculture and Waste sectors relative to 1990 (by about 7% and 13% respectively), the share of these sectors in national emissions has decreased.

The Industrial Processes sector, which emissions are generated as sub-products of non-energy activities, represented roughly 8% of national emissions in 2004, increasing by 52% since 1990. Such growth is related to the increase in the production of cement, road pavements, use of limestone and dolomite, and the production of lime, glass and ammonia.

The Solvents and Other Product Use represents less than 1% of total emissions (without LULUCF) and is associated with emissions of Non-Methanic Volatile Organic Compounds (NMVOC).

2.3.2 Analysis by Gas

Greenhouse gas emissions have risen in the period from 1990 to 2004 (Figure 35), with CO_2 recording the most significant growth.

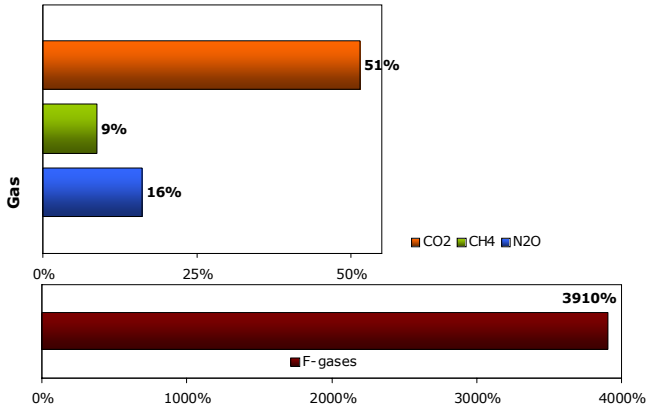

Figure 35. GHG emissions increase between 1990 and 2004 (by gas)

Source: IAa, 2006

Figure 36 shows the relative contribution of each of the GHG to the emissions total for the base year (1990 for all GHG, except 1995 for fluorinated gases) and 2004.

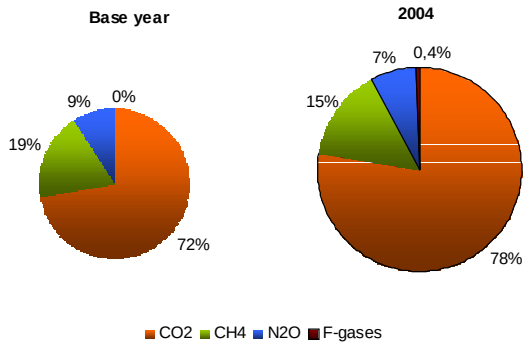

Figure 36. GHG emissions by gas in the base year and in 2004[51]

Source: IAa, 2006

[51] Portugal chose 1995 as the base year for fluorinated gases.

The burning of fossil fuels in energy related activities (IPCC sector 1) is the primary source of CO_2. Other non-energy related production processes, such as cement production (category 2A), are also significant contributors.

CH_4 is mainly produced from anaerobic decomposition of organic matter in biological systems, such as urban waste and livestock waste, wastewater treatment systems or enteric fermentation in animals. Other sources that are equally responsible for CH_4 emissions include the burning of biomass, natural gas and oil distribution and the incomplete burning of fossil fuels.

N_2O is associated to direct and indirect emissions from agricultural soils, mostly related to the use of synthetic fertilisers and manure from cattle, nitrogen fixing by leguminous crops and the incorporation of agricultural residues in the soil. Other significant sources include the chemical industry (nitric acid production), wastewater treatment, burning of fossil fuels (mainly in the transport sector) and burning of biomass (forest fires, agricultural residues, biomass combustion in the residential sector and waste incineration).

The fluorinated gases encompass hydrofluorocarbons (HFC) and sulphur hexafluoride (SF_6). The first are the result of leaks in the production, operation and decommissioning of cooling and air conditioning equipments, foams, fire protection equipment and inhalators. The latter result from losses in electricity distribution systems, circuit breakers and metal-clad substations.

2.4 Analysis of Key Drivers

The key drivers explaining the increase in national emissions for this period are, among others, economic growth and increase in energy demand, traffic volume and distances covered by road transport (supported by the development of road infra-structures and the increase in the number of private vehicles). Meteorological parameters, such as precipitation, which have a high inter-annual variability, also have a significant influence on hydroelectric power production, thus influencing in a very significant manner the fluctuations in emissions.

Portugal registered rapid economic growth in the 1990s, with GDP increasing by 38.6% between 1990 and 2004, an annual variation of 2.8%. The most significant growth was observed between 1993 and 2000, with an average annual growth of 4.4% during the period. This economic growth was followed by a 5% annual average increase in primary energy consumption; in 2004, energy consumption was about 1.5 times higher than that recorded in 1990 (Figure 37).

Throughout this period, Portugal did not manage to decouple GHG emissions and economic growth. However, there was a slight decrease in carbon intensity of the economy (emissions per unit of GDP) in recent years, a fact that may be explained by the implementation of some policies and measures with positive effects on GHG emissions such as the introduction of natural gas, the introduction of combined cycle gas thermal electric plants, the progressive installation of co-generation units, energy and technology efficiency improvements in industrial processes and improvements in fuel quality.

However, energy intensity is still growing moderately, reflecting growth both in the Transport as well as Residential and Services sub-sectors, and the latter registering an increase in electricity demand.

The slowing of economic growth since 2001 has contributed to a more moderate increase in emissions in recent years. However, recent emissions levels reveal significant fluctuations related to the high variability in hydroelectricity generation, which is strongly dependent on the current levels of precipitation, technically known as the hydraulic index (IPH). 2002 was a dry year (IPH of 0.76), resulting in a reduction in hydroelectricity production and a consequent increase in GHG emissions. In contrast, 2003 was a year with a high IPH (rainfall figures 33% above those of the average hydrological year) thus increasing hydroelectric production and decreasing CO_2 emissions from thermal power plants.

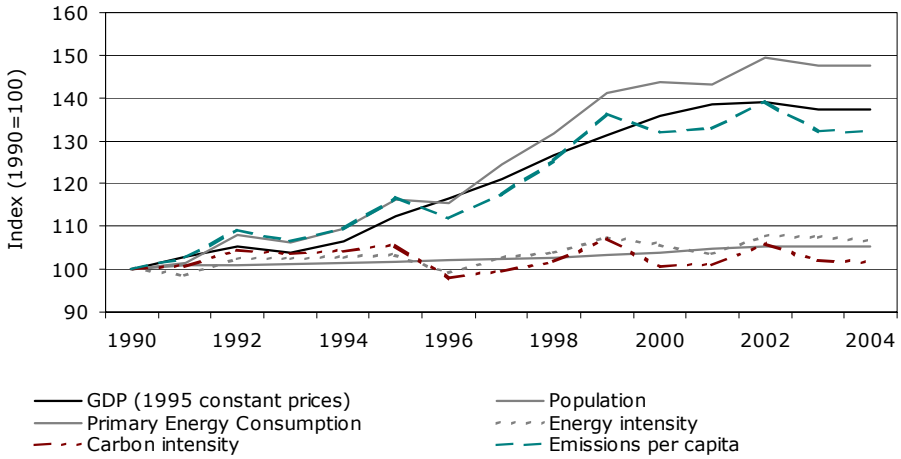

Figure 37. GHG emissions per capita, per unit GDP and relative to energy consumption[52]
Source: INEa and DGGE, 2005

The influence of hydroelectric production on emissions is evident from Figure 38. The higher IPH values are matched by the lowest emissions values from electricity and heat production (1996 and 2003, for instance). The inverse can be observed in the years 1992, 1999 and 2002, whereby low IPH is matched by highest emissions values for those categories.

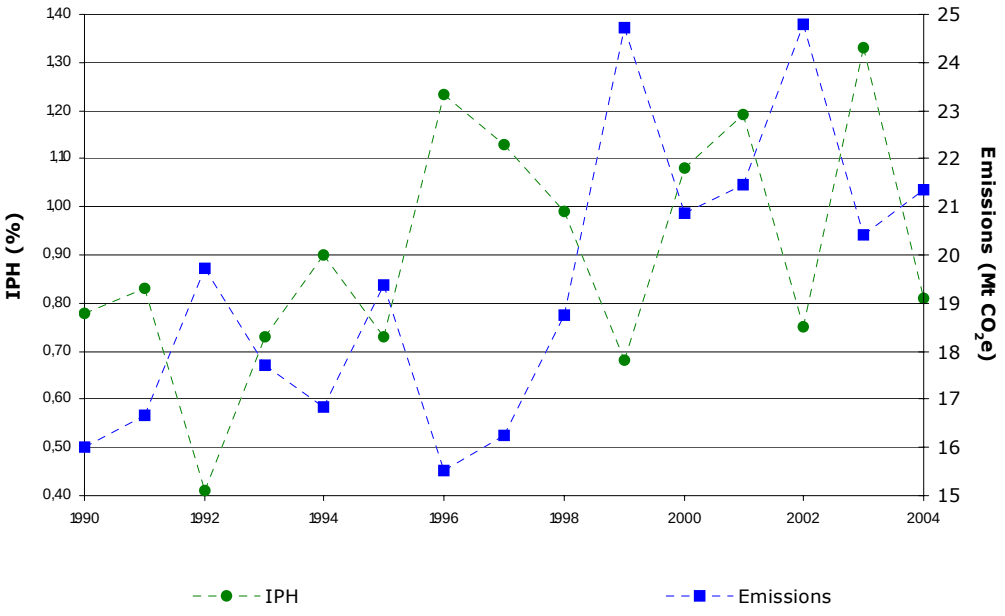

Figure 38. Hydraulic index (IPH) and emissions from power and heat production
Source: IAb, 2006

[52] Primary Energy Consumption; GDP at 1995 prices and energy intensity as the ratio between energy consumption and GDP.

3 Policies and Measures and the Use of Kyoto Protocol's Mechanisms

The National Climate Change Programme[53] (PNAC 2004) is the main strategic instrument for compliance with GHG limitation commitments in the context of the Kyoto Protocol and the European Union Burden Sharing Agreement[54] (a 27% increase in GHG emissions by 2008-2012, relative to 1990).

Preparatory work for PNAC 2004 started in 2000, and has since been developed in close cooperation with stakeholders, in particular economic agents of the relevant sectors and competent sectoral public administration departments. The draft version was subject to public discussion at two stages of the process (in 2001 and 2003/2004).

More recently, in the second semester of 2005, a review process of PNAC 2004 was initiated. The resulting document (PNAC 2006), which was provisionally approved by the Council of Ministers on the 1st June 2006, evaluates Portugal's path towards meeting its first commitment period target under the Kyoto Protocol, taking into account the updating of macroeconomic information and activity variables of the various sectors, as well as the assessment of the implementation of policies and measures in force.

PNAC 2006 contains a set of measures defined for the sectors of the economy with an impact on GHG emissions: Energy (demand and supply, including the sub-sectors Transport, Residential and Services, and Industry), Agriculture and Livestock, Forestry and Waste. The reference scenario under PNAC 2006 integrates policies and measures (MR) with an impact on GHG emissions reduction implemented or adopted by the 1st January 2005 (including the activities of afforestation, reforestation and deforestation under art. 3(3) of the Kyoto Protocol). Additional policies and measures (MA), adopted or at the planning stage after that date, were also considered, including forest management, cropland management and grazing land management activities, under art. 3(4) of the Kyoto Protocol.

Policies and measures included in the PNAC are pursuant to European Community (EC) Directives transposed into national legislation and the application of other types of EU instruments, namely in the context of the European Climate Change Programme (ECCP), as well as measures specifically developed by Portugal. Both the framework programmes and the specific instruments for the limitation of national GHG emissions have been approved by Government and duly published in the *Diário da República*.

The measures included in the reference scenario result in an estimated reduction potential of about 7.3 Mt CO_2e during the first commitment period of the Kyoto Protocol. Additional measures contribute a further emissions reduction potential of about 3.7 Mt CO_2e. The overall package of policies and measures defined in PNAC 2006 are expected to have an impact of about 11 Mt CO_2e.

This set of policies and measures is complemented by the positive benefits of the introduction of natural gas, the entering into operation of combined cycle gas turbines and the progressive installation of co-generation units, improvements in the energy and technology efficiency of industrial processes and improvements in the quality of fuels.

The information herein presented is, therefore, the latest update (June 2006) of the estimates of the GHG emissions reduction potential of a vast set of policies and measures under implementation, adopted and planned for all sectors of activity with relevant contribution to the emissions balance.

[53] Approved by Council of Ministers Resolution 119/2004, of 31 July.

[54] Decision 2002/358/CE of the Council, of 25 April 2002, on the approval, on behalf of the European Community, the Kyoto Protocol to the United Nations Framework Convention on Climate Change, and the joint compliance of their commitments. OJ L 130, of 15 May, pp. 1–20. Under this decision, the Member-States are jointly responsible for European Union's compliance with its quantified reduction objective. In this context, Portugal should not exceed, in the 5 year compliance period, its Assigned Amount (AA) of 385 970.45 kt CO_2e.

3.1 Policies and Measures in the Energy Sector

3.1.1 Energy Supply, Industry, Construction, Public Works and Others (including Residential and Services)

Table 13. Policies and Measures for the energy supply, industry, construction and public works and other (including residential and services) sub-sectors

Designation of P&M	Objective and/or affected activity	GHG	Type of Instrument	Implementation Status	Implementing Bodies	Estimation of the GHG reduction impact (kt CO_2e)		
						2005	2010	2020
MRe1. "E4, E-RES" Programme	Reduction of GHG emissions from electricity production through the increase in generation from renewable energy sources (meeting a 39% target of gross electricity consumption by 2010 with RES)	CO_2 CH_4 N_2O	Economic (investment subsidies and specific tariffs for E-RES generation)	Under implementation	MEI MAOTDR Companies with contracts in electricity, transport and distribution Promoters of E-RES projects	NA	280	[High Scenario] 1273 [Low Scenario] 893
MRe2. Energy Efficiency in Buildings	Increase energy efficiency in buildings by about 40% through the adoption of new regulation(s) on acclimatisation and thermal behaviour of buildings, in substitution of present regulations	CO_2 CH_4 N_2O	Regulatory	Under implementation	MOPTC MEI MAOTDR Bodies in charge of building certifications	-	90	[High Scenario] 500 [Low Scenario] 331

Designation of P&M	Objective and/or affected activity	GHG	Type of Instrument	Implementation Status	Implementing Bodies	Estimation of the GHG reduction impact (kt CO_2e)		
						2005	2010	2020
MRe3. Solar Hot Water for Portugal Programme (AQSpP)	Promotion of domestic water heating by solar energy. Initial target of 1 million m^2 of solar panels installed by 2010 (around 150 000 m^2 per year) altered to sustaining in 2005 and 2006 the growth rate of past few years. An installation rate of 100 000 m^2/year is considered for the following years (2007-2020), with the entry into force in 2006 of new legislation	CO_2 CH_4 N_2O	Economic (tax incentives)	Under implementation	MEI MFAP Bodies in charge of certification and installation of equipment Sector Agents (manufacturers, installers among others).	NA	101	High Scenario] 322 [Low Scenario] 312
MAe1. Energy efficiency improvement in the electricity generation sector	Reduction of the rate of loss in the energy transport and distribution network to 8.6%[55] by 2010	CO_2 CH_4 N_2O	Regulatory	Under planning	ERSE Concessionaires of the electricity transport and distribution network	-	146	[High Scenario] 217 [Low Scenario] 113
MAe2. Energy efficiency improvement in the energy supply systems, considering electricity generation from co-generation	Increase in electricity generated from co-generation systems, up to a share of 18% of the gross national consumption of electricity in 2010.	CO_2 CH_4 N_2O	Economic (investment subsidies and specific tariffs for co-generation)	Under implementation	MEI Concessionaires of the electricity transport and distribution network Companies with co-generation facilities or potential owners Enterprise and co-generation associations	-	200	[High Scenario] 185 [Low Scenario] 103

[55] This measure impacts on EU-ETS facilities.

Designation of P&M	Objective and/or affected activity	GHG	Type of Instrument	Implementation Status	Implementing Bodies	Estimation of the GHG reduction impact (kt CO_2e)		
						2005	2010	2020
MAe3. Improvement in energy efficiency from the electricity demand-side	Reduction of electricity consumption by about 1000 GWh by 2010	CO_2 CH_4 N_2O	Regulatory	Under Planning	ERSE Electricity distribution companies Electricity consumers (companies, public and private organisms and the residential sector)	-	795	[High Scenario] 420 [Low Scenario] 340
MAe4. Promotion of electricity produced from renewable energy sources	Increase installed capacity of units of electricity generation from RES to yield up to 5100 MW of wind power	CO_2 CH_4 N_2O	Economic (investment subsidies and specific tariffs for E-RES generation)	Under implementation	MEI MAOTDR Concessionaires of the electricity transport and distribution network Promoters of E-RES projects	-	855	[High Scenario] 0 [Low Scenario] 0
MAe5. Introduction of natural gas in the Autonomous Region of Madeira	Substitution of the most polluting fuels and diversification of energy sources in the Autonomous Region of Madeira	CO_2 CH_4 N_2O	Regulatory	Under Planning	Regional Government Autonomous Region of Madeira	-	5	[High Scenario] ND [Low Scenario] ND
MAr1. Realignment of the tax burden on diesel fuel for heating (residential sub-sector)	Tax harmonization between diesel fuel for heating and for transport by 2014[56]	CO_2 CH_4 N_2O	Economic/ Tax	Under Planning	MEI MFAP	-	14	[High Scenario] 54 [Low Scenario] 53

[56] The reduction potential includes the indirect effect of the increase in emissions in the electricity generation system.

Designation of P&M	Objective and/or affected activity	GHG	Type of Instrument	Implementation Status	Implementing Bodies	Estimation of the GHG reduction impact (kt CO_2e)		
						2005	2010	2020
MAs1 Realignment of the tax burden on diesel fuel for heating (services sub-sector)	Tax harmonization between diesel fuel for heating and for transport by 2014[57]	CO_2 CH_4 N_2O	Economic/ Tax	Under Planning	MEI MFAP		59	[High Scenario] 330 [Low Scenario] 323
MAi1. Increase in tax on industrial fuels	Changing the fuel tax (ISP) on industrial fuels, so as to create an incentive structure for GHG emissions reduction[58]	CO_2 CH_4 N_2O	Economic/ Tax	Under Planning	MEI MFAP	-	78	[High Scenario] 102 [Low Scenario] 93
MAi2. Review of the Regulation on the Management of Energy Consumption (RGCE)	Defining of a new RGCE that promotes energy efficiency in the industrial sector through voluntary agreements[59]	CO_2 CH_4 N_2O	Voluntary Agreement	Under Planning	MEI MFAP	-	32	[High Scenario] 60 [Low Scenario] 54
MAi3. Incentives to the substitution of fuel oil co-generation by natural gas generation	Reduction or phasing-out of the tariff for co-generation using fuel oil[60]	CO_2 CH_4 N_2O	Economic	Under Planning	MEI MFAP	-	189	[High Scenario] 196 [Low Scenario] 196

[57] The reduction potential includes the indirect effect of the increase in emissions in the electricity generation system.

[58] This measure has impact on EU-ETS facilities

[59] The reduction potential includes the indirect effect of the increase in emissions in the electricity generation system

[60] This measure has impact on EU-ETS facilities.

3.2 Transport

Table 14. Policies and measures for the transport sector

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Estimation of the impact in the reduction of GHG (kt CO_2e)		
						2005	2010	2020
MRt1. Auto-Oil Programme – Voluntary agreement with the car manufacturing associations (ACEA, JAMA, KAMA)	Reduction of the carbon intensity of light passenger vehicles transport through the manufacture of new cars, with increasingly restrictive consumption (and CO_2 emissions) standards, as to reach the 120 g CO_2e/km target by 2010	CO_2 CH_4 N_2O	Voluntary Agreement	Under implementation	MFAP MAI	NA	175	NA
MRt2. Expansion of the Lisbon Metro (ML)- extension of the Blue Line; extension of the Yellow Line; Red Line	Promotion of modal transfer, and consequent reduction in carbon intensity of the entire transport sector, through the expansion of the Lisbon Metro network	CO_2 CH_4 N_2O	Economic (increase in the supply of public transport)	Under implementation	ML	NA	14.8	NA
MRt3. Construction of the South of the Tagus River Metro (MST)	Promotion of modal transfer, and consequent reduction in carbon intensity of the entire transport sector, through the expansion of the Metro network	CO_2 CH_4 N_2O	Economic (increase in the supply of public transport)	Under implementation	MST	-	13	NA
MRt4. Construction of the Oporto Metro (MP)	Promotion of modal transfer, and consequent reduction in carbon intensity of the entire transport sector, through the expansion of the Lisbon Metro network	CO_2 CH_4 N_2O	Economic (increase in the supply of public transport)	Under implementation	MP	NA	30.4	NA
MRt5. Construction of the Mondego Light Metro (MLM)	Promotion of modal transfer, and consequent reduction in carbon intensity of the global transport activity through the expansion of the Metro network	CO_2 CH_4 N_2O	Economic (increase in the supply of public transport)	Under Planning (re-formulation)	MLM	-	NA	NA

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Estimation of the impact in the reduction of GHG (kt CO_2e)		
						2005	2010	2020
MRt6. Supply changes (reduction in travel time) between Lisbon-Oporto; Lisbon-Castelo Branco; Lisbon-Algarve	Promotion of modal transfer, and consequent reduction in carbon intensity of the global transport activity through supply changes (reduction in travel time) between Lisbon-Oporto; Lisbon-Castelo Branco and Lisbon-Algarve, and consequent increase in the competitiveness of the railway system	CO_2 CH_4 N_2O	Economic (increase in the supply of public transport)	Under implementation	CP REFER	-	78	NA
MRt7. Enlargement of the fleet of vehicles powered by natural gas of CARRIS and of the STCP	Reduction of carbon intensity of heavy passenger vehicle transport, through the enlargement of the fleet of public vehicles powered by natural gas (of CARRIS and of the STCP), and the substitution of diesel-powered vehicles	CO_2 CH_4 N_2O	Economic (promotion of the investment in vehicles powered by natural gas)	Under implementation	CARRIS STCP DGTT	NA	1.2	NA
MRt8. Incentive Programme for the dismantling of End-of-Life Vehicles	Promotion of the renovation of the car stock, in order to reduce carbon intensity of light passenger vehicles, through the provision of monetary incentives for the substitution of end-of-life vehicles. 4200 vehicles over 10 years old are expected to be decommissioned annually from 2005	CO_2 CH_4 N_2O	Economic (monetary incentives for the acquisition of new vehicles)	Under implementation	MAI	NA	2.9	NA
MRt9. Reduction of motorway speeds	Promotion of the reduction of speeds and consequent reduction of the carbon intensity of road transport by lowering the average motorway speed by about 6 km/h, in relation to year 2000 in the frame of an accident prevention programme	CO_2 CH_4 N_2O	Regulatory/ Formation	Under implementation	MAI	-	0.6	NA

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Estimation of the impact in the reduction of GHG (kt CO_2e)		
						2005	2010	2020
MRt10. Biofuels Directive	Reduction in the consumption of fuels responsible for the emission of GHG through the promotion of the use of biofuels in the transport sub-sector (2%-2005; 5.75%-2010)	CO_2 CH_4 N_2O	Economic (concession of subsidies to investment and proper tariffs for biofuels)	Under implementation	MEI MFAP	-	1243	NA
MAt1. Reduction of Taxis´ service days	Reducing the number of service days to a maximum of 6 days per week	CO_2 CH_4 N_2O	Regulatory	Under Planning	MOPTC	-	3.9	NA
MAt2. Enlargement of the fleet of taxi vehicles powered by natural gas	Promotes the shift to natural gas in 200 vehicles	CO_2 CH_4 N_2O	Economic (promotion of investment in natural gas-powered vehicles)	Under Planning	MOPTC	-	0.2	NA
MAt3. Review of the current tax regime on private vehicles	Energy efficiency improvements of the car stock through the revision of the present taxation regime on private vehicles, so that CO_2 emissions are factored in the calculation of the tax (representing at least 60% of the total value of the tax from 2008)[61]	CO_2 CH_4 N_2O	Economic and Tax	Under Planning	MOPTC MFAP	-	7.7	NA
MAt4. Metropolitan Authority of Lisbon Transports	Modal transfer of 5% (pkm/pkm) by 2010	CO_2 CH_4 N_2O	Regulatory and Economic (change in the supply of public transport)	Under Planning	MOPTC AML	-	245.4	NA
MAt5. Metropolitan Authority of Oporto Transports	Modal transfer of 5% (pkm/pkm) by 2010	CO_2 CH_4 N_2O	Regulatory and Economic (change in the supply of public transport)	Under Planning	MOPTC AMP	-	101.5	NA

[61] The impact of this instrument is considered under the full compliance with the Auto-Oil Programme.

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Estimation of the impact in the reduction of GHG (kt CO_2e)		
						2005	2010	2020
MAt6. Incentive Programme for the dismantling of End-of-Life Vehicles (further objectives)	Extra 500 vehicles decommissioned annually relative to the 4200 considered in measure MRt8	CO_2 CH_4 N_2O	Economic (monetary incentive for the acquisition of new vehicles)	Under Planning	MAI	-	0.4	NA
MAt7. Regulation on Energy Management in the Transport Sector	5% reduction of the consumption factor of freight transport	CO_2 CH_4 N_2O	Regulatory	Under Planning	MOPTC MEI	-	18.1	NA
MAt8. Railway connection to Aveiro Sea Port	Transfer of 1553 kt of freight to maritime transport, yearly, from 2007	CO_2 CH_4 N_2O	Economic (change in the supply of freight transport)	Under Planning	MOPTC	-	40	NA
MAt9. Shipping routes	Transfer of 20% of international road freight traffic to maritime transport	CO_2 CH_4 N_2O	Economic (change in the supply of freight transport)	Under Planning	MOPTC	-	150	NA
MAt10. Logistical Platforms	Development of the National Logistics System	ND	Economic	Under Planning	MOPTC	-	In evaluation	NA
MAt11. Restructuring of supply of CP (national railway) service	Renovation of trains and changes at the supply level (schedules and frequency of services, new connections/services, etc.) so as to capture $261x10^6$ tkm of the road transport mode.	CO_2 CH_4 N_2O	Economic	Under Planning	MOPTC CP	-	44.4	NA

3.3 Policies and Measures for the Agriculture and Livestock Sector

Table 15. Policies and measures for the agriculture and livestock sector

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Estimation of the impact in the reduction of GHG (kt CO_2e)		
						2005	2010	2020
MRg1. IPPC Directive (Integrated Prevention and Pollution Control)	Implementation of the IPPC Directive	-	Regulatory	Under Planning	-	-	No Evaluation	NA
MAg1. Evaluation and promotion of carbon sequestration in agricultural soil	Adoption of cropland management and grazing land management activities, under the Art. 3(4) of the Kyoto Protocol	CO_2	Economic	Under Planning	MADRP MAOTDR	-	500	NA
MAg2. Treatment and energy recovery of livestock waste	Reduction in methane emissions resulting from manure management through the conversion of medium and large manure management systems (headcount over 1000) to anaerobic biodigestors with energy recovery 945 000 heads associated to the Liz, Oeste, Algarve, Setubal e Rio Maior systems	CH_4 N_2O	Economic (Promotion of investment in waste-to-energy recovery systems)	Under implementation	MADRP MAOTDR Local authorities	NA	429	507

3.4 Policies and Measures for the Forestry Sector

Table 16. Policies and measures for the forestry sector

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Estimation of the impact in the reduction of GHG (kt CO_2e)		
						2005	2010	2020
MRf1. Programme for the Sustainable Development of Portuguese Forests (in the context of IIIFSP)	Promote the sustained increase in forested area, through financial support and incentives to new tree plantations	CO_2	Economic (financial support and incentives to the establishment of new tree plantations)	Under implementation	MADRP	3100	3743	4300
MAf1. Promotion of carbon sink capacity of forests	Increase in the carbon sink capacity of Portuguese forests, through the improvement of forestry management (forest stands in place on the 1st of January 1990).	CO_2	Economic	Under Planning	MADRP	-	800	NA

3.5 Policies and Measures for the Waste Management Sector

Table 17. Policies and measures for the waste management sector

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Estimation of the impact in the reduction of GHG (kt CO_2e)		
						2005	2010	2020
MRr1. Directive on Packaging and Packaging Waste	Decree-Law 366-A/97, of 20 December, transposed the EC Directives that manage the flow of packaging and related waste (Directive 94/62/CE of the European Parliament and Council, of 20 December, altered by Directive 2004/12/CE of the European Parliament and Council, of 11 February) imposing recovery and recycling objectives for packaging waste. The following targets, to be met by the 31st December 2012, were defined: - recovery: of at least 60% of waste - Recycling: Overall: 55-80% Glass: 60% Paper: 60% Metals: 50% Plastics: 22,5% Wood: 15%	CO_2 CH_4 N_2O	Economic	Under implementation	MAOTDR Waste treatment and management Entities/Companies	NA	900	NA

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Estimation of the impact in the reduction of GHG (kt CO_2e)		
						2005	2010	2020
MRr2. Landfill Directive	Decree-Law 152/2002, of 23 May, transposed Directive 1999/31/CE of the Council, of 26 April, on the disposal of waste to landfills, establishes the need to define a national strategy to reduce biodegradable municipal waste (BMW) destined to landfills. Maximum percentage of BMW disposed in landfills in relation to the BMW production in 1995 (targets): 2006 (75%); 2009 (50%); 2016 (35%)	CH_4	Economic	Under implementation	MAOTDR Waste treatment and management Entities/Companies	NA	363	NA
MRr3. IPPC Directive (Integrated Prevention and Pollution Control)	The IPPC Directive was transposed to internal legislation by Decree-Law 194/2000, of 21 August. Waste Management (Category 5) includes a set of activities of Annex I of DL 194/2000. Improvement of environmental performance of facilities covered with regard to: discharges to the atmosphere, water and soil; waste production; use of raw materials, energy efficiency, noise, risk prevention and management, among others (Time Horizon: 2007-2010)	CO_2 CH_4	Regulatory	Under implementation	MAOTDR Waste treatment and management bodies/companies	The Environmental Licences for waste management facilities (Category 5) already issued in the context of IPPC, in particular for atmospheric emissions control, do not specify any level of environmental performance to be fulfilled, but rather impose the periodic monitoring of emissions As such, the IPPC Licensing, as defined to date, is a rather ineffective instrument for GHG reduction. However, the information collected (quantities and composition of waste, atmospheric emissions, etc.) will allow for future monitoring of the reference scenario defined for the waste sector		

3.6 Cross-Cutting Policies and Measures

Cross-cutting P&M adopted by Portugal include the European Union Emissions Trading System (EU-ETS), the Fluorinated Gases Directive and the Green Public Procurement System.

The EU-ETS was established by Directive 2003/87/EC of the European Parliament and of the Council, of 13th October, and transposed to national legislation by Decree-Law 233/2004, of 14th December, which was later altered by Decree-Laws 243-A/2004 of 31st December and 230/2005, of 29th December. The Council of Ministers Resolution 53/2005, of 3rd March, approved the National Allocation Plan (PNALE I) for the period from 2005 to 2007. Decree-Law 72/2006, of 24th January, alters Decree-Law 233/2004 and transposes to national legislation the Linking Directive[62] that allows EU-ETS operators to use emission credits generated through eligible project activities under the Kyoto Protocol.

The total amount of emissions allowances awarded to Portugal in the 2005-2007 period is 38.16 Mt CO_2 (representing approximately 47% of national emissions), of which 36.90 Mt CO_2 corresponds to the 244 installations listed in PNALE, and the remaining 1.26 Mt CO_2 is set aside as a reserve for new entrants. This reserve amount will be cancelled in case it is not used.

PNALE II[63] for the period 2008-2012 stipulates a limit value of 33.93 Mt CO_2/year for existing installations covered under the EU ETS, corresponding to a total of 169.65 Mt CO_2.

Further information on the EU-ETS can be found in the European Union's Demonstrable Progress Report.

3.7 Monitoring and Evaluation of the National Climate Change Programme

The Monitoring and Evaluation Programme of PNAC, approved by Council of Ministers Resolution 59/2005, has a two-fold objective: identifying situations requiring the application of sanctions, namely through active information schemes, and identifying the need for the timely deployment of new policies and measures to come into force in the beginning of 2008.

Implementation of the policies and measures in the PNAC 2004 reference scenario, in force by the 31st December 2004, was monitored and evaluated in the context of the PNAC 2004 review, to assess progress towards the defined sectoral targets. The results were integrated in the new climate change programme – PNAC 2006.

Table 18 summarises the variables used, as well as the distance to the 2004 target[64].

[62] Directive 2004/101/EC of the European Parliament and of the Council, of 27 October.

[63] June 2006 version, presently under public consultation.

[64] Distance to 2004 target (31st December) represents the distance, as a percentage, of the real sectoral achievement relative to the defined target.
The 2004 value was obtained from the trend line estimated for the period at stake. The objective is to evaluate: the status of implementation in 2004 relative to what was initially planned; expected deviation relative to the 2010 target; deviation (positive or negative) of environmental efficacy measured by the impact on GHG emissions. A minus sign (-) shows that the status of implementation is below the planned target, while a positive sign (+) shows otherwise.

Table 18. Monitoring and evaluation of the policies and measures in the PNAC

Designation of P&M	Monitoring variable/ target in 2010	Distance to target (31 December 2004)	Expected deviation (2010)
Energy Supply			
MRe1. "E4, E-RES" Programme	% of electricity generation from RES relative to gross electricity consumption/ Production of 39% of gross electricity consumption from RES	-4.2 %	-0.2 %
Expansion Plan for the electricity generation system Increase in energy efficiency in the electricity generation sub-sector with the introduction of new and more efficient combined cycle units powered by natural gas	Specific average consumption of the new units/ Specific consumption of the new units lower than 0.175 m^3N/kWh: 0.1656 m^3N/kWh for the first 3 new units and to 0.158 m^3N/kWh for following units	0 %	0 %
MRe2. Energy Efficiency in Buildings (RCCTE – Regulation of the Characteristics of the Thermal Behaviour of Buildings)	Year of publication of the new regulation on thermal efficiency of new buildings/ Implementation of the new RCCTE from 2004 onwards, with a 40% increase in the thermal efficiency of new buildings relative to the previous RCCTE (1991 version)	Measure yet to be adopted because the legal instrument was published in April 2006	2 years or about 25 ktep of extra consumption
MRe3. Solar Hot Water for Portugal Programme Promotion of domestic water heating with solar energy	Area (m^2) of solar collectors installed and operational/ Total of 1 million m^2 of solar collectors installed and operational	Roughly 16 000 m^2 of solar collectors installed in 2004; 9200 m^2 installed in 2003	-50 %

Designation of P&M	Monitoring variable/ target in 2010	Distance to target (31 December 2004)	Expected deviation (2010)
Transport[65]			
MRt1. Auto-Oil Programme – Voluntary agreement with the car manufacturing associations (ACEA, JAMA, KAMA)	Emission factor of new vehicles sold/ 2010: 120 gCO_2e/vkm	+9.4 %	0 %
MRt2i. Expansion of the Lisbon Metro (ML) - extension of the Blue Line	Modal transfer to the ML – captured passengers (pkm)/ – Blue line 2010: -38 284 582[TI]; -46 992 689[BUS]; +9 261 176[added ML] => +94 538 447[ML]	-63 %	0 %
MRt2ii. Expansion of the Lisbon Metro (ML) – extension of the Yellow Line	Modal transfer to the ML – captured passengers (pkm) – Yellow line 2010: -29 094 900[TI]; -110 005 500[BUS]; +41 931 600[added ML] => +181 032 000[total ML]	-40 %	0 %
MRt2iii. Expansion of the Lisbon Metro (ML) – Red Line	Modal transfer to the ML – captured passengers (pkm)/ – Red line 2010: -40 508 400[TI]; -84 429 400[BUS]; +4 624 000[added ML] => +129 561 800[total ML]	-100 %	-5.5 %
MRt3. Construction of the South of the Tagus River Metro (MST)	Modal transfer to the MST – captured passengers (pkm)/ 2010: -47 304 000[TI]; -69 309 000[BUS]; +17 490 000[Induced] => +134 103 000[MST]	0 % (Expected to start in 2005)	-17 %
MRt4. Contruction of the Oporto Metro (MP)	Modal transfer to the MP – captured passengers (pkm)/ 2010: -210 468 971[TI]; -239 827 000[BUS]; -70 836 277[CP-Oporto] => +521 132 237[MP]	-85 %	+9.4 %
MRt5. Construction of the Mondego Light Metro (MLM)	Modal transfer to the MLM – captured passengers (pkm)/ 2010: -69 300 000[TI]; -241 542 000[BUS]; -49 770 000[TFC]; +17 388 000 [Induced] => +378 000 000[MLM]	-100 % (The beginning of the second phase of operation is expected for 2011)	-100 %

[65] TI – Individual transport; BUS – Public road transport; TFC – Train

Designation of P&M	Monitoring variable/ target in 2010	Distance to target (31 December 2004)	Expected deviation (2010)
MRt6i. Supply changes (reduction in travel time) between Lisbon-Oporto)	Modal transfer to the railway – captured passengers (pkm) 2010: -468 100 000[TI]; -198 500 000[BUS]; +346 000 000[Induced] => +1 013 100 000[CP]	-10.7 %	-16 %
MRt6ii. Supply changes (reduction in travel time) between Lisbon-Castelo Branco	Modal transfer to the railway – captured passengers (pkm)/ 2012: -8 900 000[TI]; -2 100 000[BUS]; +25 900 000[Induced] => +36 900 000[CP]	+121 %	+85 %
MRt6iii. Supply changes (reduction in travel time) between Lisbon-Algarve	Modal transfer to the railway – captured passengers (pkm)/ 2012: -83 600 000[TI]; -6 200 000[BUS]; +81 800 000[Induced] =>+177 900 000[CP]	-12 %	0 %
MRt7. Enlargement of the natural gas (NG) powered vehicle fleet of CARRIS and STCP	Diesel fuelled vehicles substituted by natural gas powered vehicles/ Increase in the fleet of natural gas vehicles in CARRIS and STCP, through the substitution of 100 diesel vehicles (50 CARRIS and 50 STCP), from 2001 to 2010.	+250 %	+220 %
MRt8. Incentive Programme for the decommissioning of End-of-Life Vehicles	Decommissioned vehicles/ 2000-2010: 137 500 (80% of 10 to 15 year-old vehicles)	-70 %	-80 %
MRt9. Reduction of motorway speeds	Average motorway speed (km/h)/ 2010: 118 km/h	+21 %	-41 %
MRt10. Biofuels Directive	Share of biofuels in total fuel consumption by road transport/ 2010: 5.75% of fuel consumption from road transport	The first sectoral target is for post-2004 (legal instrument published in March 2006 – Decree-Law 62/2006)	0 %
Forestry			
New tree plantations areas	New forest area/ 2010: 600 000 ha	-18 %	-18 %
Waste			
MRr1. Directive on Packaging and Packaging Waste	2012: 60% of packages recovered; and 55% of packages recycled	Recovery: +14.5 % (2003) Recycling: +24.5 % (2003)	Recovery: +15 % Recycling: +8 %
MRr2. Landfill Directive	Biodegradable Municipal Waste (BMW) disposed in landfills relative to the quantity produced in 1995/ 2009: 50% of BMW	+17 % (2003)	+18 % (2009)

Source: IAa, 2006

3.8 Information on National and Regional Programmes and/or Legislation Initiatives, and Coercive Administrative Procedures

Environmental protection is regulated by the Framework Law on the Environment (Law 11/87 of 7 April)[66]. This law postulates a general protection principle which is that all citizens have the right to an ecologically balanced human environment and the duty of protecting it, while the State is entrusted with improving the quality of life, both individual and collective, through the activities of its institutions, as well as through grassroots and community initiatives.

This Framework Law contains a series of clauses on preventive and repressive interventions, concerning the environment, which can be carried out by the Public Administration, such as: articles 33 and 36, on licensing and emergency situations; article 42, on administrative embargos; and article 47, on environmental infractions. In short, the Law defines the institutions responsible for environmental policy and their main types of intervention.

Such law, in coordination with the other sectoral policies, sets the frame for Portugal's climate change policy, namely through national and Community legislation for the implementation of the UNFCCC and the Kyoto Protocol.

As an EU Member State, Portugal is subject to compliance with Community rules, and in particular the extensive body of legislation with relevance to climate change policy, namely the Burden Sharing Agreement (Council Decision 2002/358/EC of 25 April), which determines the GHG emissions limitation objective (following from article 4 of the Protocol), and Decision 280/2004/EC, of the European Parliament and Council, of 11 February 2004, on the creation of a mechanism for monitoring Community GHG emissions and for implementing the Kyoto Protocol.

3.9 Participation at ICAO and IMO Decison-making Process

Portugal has participated regularly and systematically in the discussions on emissions from the international air and maritime transport sub-sectors, both at UNFCCC and Community levels (namely with regard to aviation), as well as in following developments by the International Civil Aviation Organisation (ICAO) and the International Maritime Organisation (IMO).

The National Civil Aviation Institute (INAC) is the responsible body for following issues relating to GHG emissions from the international civil aviation sector, ensuring the country's participation at the various international fora, both at the level of the ECCA[67] at the meetings of Director-Generals, and the ICAO, at the plenary sessions of the Assembly.

The Port and Sea Transport Institute (IPTM) has been directly involved in the International Maritime Organisation through meetings of the Marine Environment Protection Committee. Portugal is preparing for the ratification of Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL).

3.10 Efforts for the Minimization of Adverse Effects

Portugal's contribution to the minimisation of the adverse effects of climate change in other Parties, particularly developing countries, is carried out through a strong commitment to implementing the Convention and the Kyoto Protocol.

[66] The analysis of the Framework Law on the Environment hereby presented was authored by Professor Dr. Diogo Freitas do Amaral and can be read at http://www.diramb.gov.pt/data/basedoc/TXT_D_9134_1_0001.htm

[67] European Conference on Civil Aviation.

As such, the policies and measures implemented, adopted or foreseen in PNAC, targeting the six GHG of the Kyoto Protocol through its broad portfolio of instruments and wide-ranging coverage of all sectors of the economy, make up a significant effort by the Portuguese Government to address climate change, including the minimization of adverse effects of such policies.

In some cases, such as measures pertaining to the diversification of primary energy sources (namely shifting to natural gas), there can simultaneously be positive effects on Portugal's emissions reduction and in the economy of some fossil fuel exporting countries.

3.11 Information on the Use of Mechanisms Foreseen in Articles 6, 12 and 17 of the Kyoto Protocol

Further to the emissions reductions achieved domestically, Portugal will resort to the flexibility mechanisms foreseen in the Kyoto Protocol in order to meet the emissions target defined in the context of the Protocol and the EU Burden Sharing Agreement, with a view to acquiring emissions credits of up to 1.86 $MtCO_2e$/year.

As such, Government entrusted the Climate Change Commission to act as the Designated National Authority (DNA) for the flexibility mechanisms, and created the Portuguese Carbon Fund to acquire credits for those mechanisms. An Executive Committee was created to manage the Portuguese Carbon Fund including:

- acquisition of GHG emissions credits, at competitive prices, through direct investments in the flexibility mechanisms of the Kyoto Protocol (Emissions Trading, Joint Implementation and Clean Development Mechanism projects);
- acquisition of GHG emissions credits, at competitive prices, through direct investments in funds managed by third parties or in other carbon market instruments;
- support to projects, in Portugal, which lead to a GHG emissions reduction, namely in the areas of energy efficiency, renewable energy, carbon sinks, CO2 capture and geological sequestration, and adoption of new technologies, as justified by the return in avoided emissions; and
- promoting the participation of public and private bodies in the flexibility mechanisms of the Kyoto Protocol.

Finally, a series of memoranda of understanding on climate change and flexibility mechanisms with several parties have either been signed or are currently under negotiation. These memoranda will form a platform for dialogue, particularly through the sharing of experience among the private sector.

3.12 Information on the National Registry System (SNR)

Portugal's National Registry System (SNR) is supported by the SERINGAS[68] software application, developed by the Caisse des Dépôts et Consignations. The registry database is managed using MS SQLserver and is installed in two cluster servers with an external storage area. Such infrastructure meets the needs of the registry system and is capable of expanding to meet future requirements. An external team of Information Technologies and Environment experts was hired to assist in the management of the registry system.

The exchange of data between the Portuguese registry and the Community Independent Transactions Log (CITL) is ensured through the SERINGAS application. This software was accredited by the EC after testing for conformity with the technical standards of transactions among registries. The Portuguese installation was tested by the EC in March (v2.7.2) and December 2005 (v2.8). The SERINGAS 2.7.2 installation was also tested by the EC in April 2005 and

[68] Système Electronique du Registre INformatisé des GAz à effet de Serre (Greenhouse Gas Effect Electronic Registry System).

considered "partially operational", before starting operations. Two types of tests were applied: a connectivity test and an individual process test, which followed the DES#7 Commission Test Scenario. A new set of tests is planned for the beginning of March 2006, with the v2.8.2 version achieving the "completely operational" status at the DES#7.

The registry has been operational since November 2005.

The application includes validation procedures to minimize discrepancies among the registry transactions and the reset rules, whenever an inconsistency is detected. Furthermore, all transactions made through the Portuguese registry are subject to CITL verification.

The registry's interface is available through an htpps protocol. A digital SSL certificate provides the authentication and encryption needed for secure online transactions. The registry's access is controlled by username and password. The account owner has to sign a contract with the registry in order to be granted access. The number of people with administration privileges is kept to minimum and all are subject to a strict confidentiality agreement. Written procedures are implemented to ensure adequate registry maintenance.

The CITL internet site provides the following information on the Portuguese registry system: a list of account users, account type, compliance period and data on the authorised representatives. The interface of the Portuguese registry system (available at https://rple.iambiente.pt/) does not provide public information to this date, although a reporting tool will be provided in future versions of the SERINGAS software.

The backup policy in place at the moment determines that the data storage is saved daily to an external storage device and that on a weekly basis the tapes containing the data are stored in a physical location different from the location of the production environment. The Portuguese Registry administrators are now evaluating the need to upgrade the current policy and implement a routine of an off-site daily backup.

The person in charge of the National Registry System (SNR) is Ms Clara Lopes. The contact address is Rua da Murgueira, 9/9A, Apartado 7585, 2611-865 Amadora, Portugal. The partner responsible for system maintenance is e-Chiron, Gestão e Aplicação de Software, S. A. (Software company), based at Edifício Premium, Alameda Fernão Lopes, n.º 16 – 10.º, 1495-190 Algés, Portugal.

4 National Greenhouse Gas Emissions Projections

The data frame for PNAC 2004 (National Climate Change Programme) dates back to 2001 and 2003 in what relates to the definition of the additional policies and measures. In the second semester of 2005, the CAC decided to start a review process of PNAC 2004, given that a set of relevant underlying assumptions had in the meantime changed, namely with regard to macroeconomic information and activity variables of the various sectors. The resulting document (PNAC 2006), which was provisionally approved by the Council of Ministers on the 1st June 2006, evaluates Portugal's path towards meeting its first commitment period target under the Kyoto Protocol. Taking into account the afore-mentioned changes, as well as the assessment of the implementation of policies and measures in force, PNAC 2006 develops a new framework of policies and measures which are more in line with current data.

Greenhouse emissions estimated and projected up to 2010 (and, were feasible, up to 2020), are systematised in PNAC 2006 considering a reference scenario and a with additional measures scenario for the period 1990-2010 (assumed as the average year of the period 2008-2012). Table 52 through to Table 74 of Annex 3 present the underlining parameters of the projections.

4.1 General Description of Projection Model

Projection estimates for national anthropogenic GHG emissions are organised according to Intergovernmental Panel on Climate Change (IPCC)[69] sectors, with fugitive emissions presented together with emissions of the Energy Supply sub-sector. These estimates are supported by the following:

- expected emissions in the reference scenario, estimated on the basis of energy demand forecasts derived from macro-economic indicators, as well as from the implementation of sectoral policies and measures, adopted or in force on the 1st January 2005 (thus excluding the EU Emissions Trading Scheme) which bear an impact on GHG emissions reduction (including afforestation, reforestation and deforestation under art. 3(3) of the Kyoto Protocol); and
- GHG emissions reductions expected from the adoption of additional policies and measures undertaken with the objective of reducing GHG emissions (including forest management, cropland management and grazing land management activities under art. 3(4) of the Kyoto Protocol).

The review of macro-economic and sectoral scenarios was supported by updated information, namely (i) new data on the national accounts for the period 2000-2005 (INE, 2006) (ii) GDP growth rate forecasts for the period 2005 to 2010 (Stability and Growth Programme 2005-2009, December 2005 version).

The integration of these new macro-economic and sectoral variables revises downward the GDP growth rates for the period 2005 to 2010 and also changes the structure of intra and intersectoral Gross Value Added (GVA) considered for the purpose of simulating energy demand in the various final consumption sectors.

Relative to the national GHG projections, the following should be noted:

- figures for the period 2000-2005 are based on historical data, namely the preliminary annual national accounts (Base year 2000) (INE 2006);
- projections for the period 2005-2010 are based on the annual GDP growth rates provided in the Stability and Growth Programme 2005-2009 (December 2005 version). The growth rate for 2010 was maintained at the same level of 2009 (the last year covered in the Programme); and

[69] In the Energy sector, Transport sub-sector is presented separately.

- projections for the period 2010-2020 are based on the annual GDP growth rates considered in the PNAC 2004 scenarios, which, in turn, are based on CISEP (CISEP, 2001) estimates, for two scenarios (high and low).

Figure 39 compares the current GDP scenario at market prices with the previous GDP scenario (PNAC 2004) using 2000 as the base year (=100).

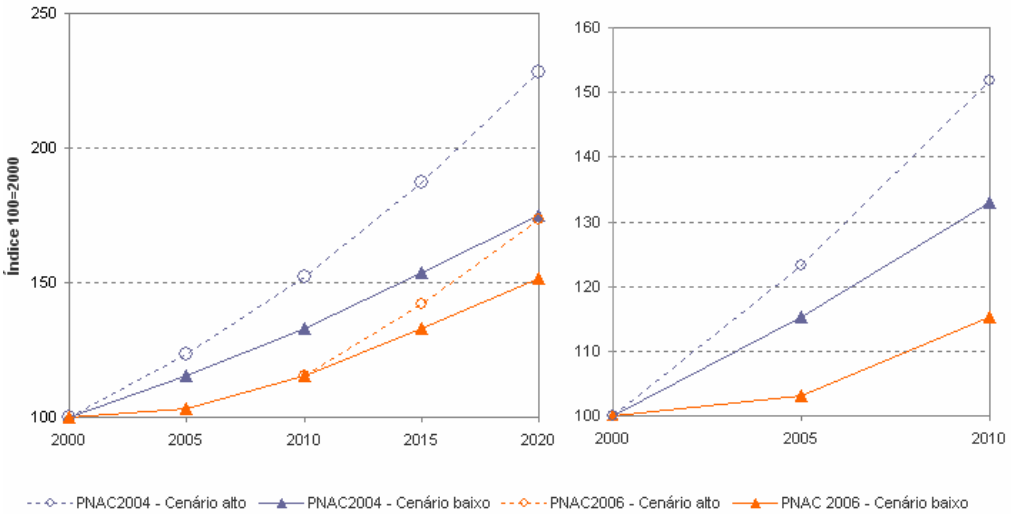

Figure 39. Trends in GDP at market prices for the 2000-2020 and 2000-2010 scenarios, and comparison between PNAC 2004 and PNAC 2006

Source: IAa, 2006

Table 19 through to Table 21 present historical data on the macroeconomic trend scenarios used in determining sectoral scenarios.

The modelling of the trend in energy consumption in the energy demand sectors, apart from residential, is based on GVA variation hypotheses (Annex 3, Table 58) for the respective sectors and sub-sectors (Agriculture; Forestry and Fisheries; Industry; Construction and Public Works; Services). A reduction in GDP growth rates and sectoral GVA will induce a reduction in energy consumption and associated GHG emissions. Also, a reduction in energy consumption in the final sectors will induce a slower growth of the energy supply sub-sectors, namely in terms of electricity production. Reduction in GDP growth also impacts on transport demand variables, namely freight transport and acquisition of new passenger vehicle fleet, with negative consequences in terms of technology efficiency and lower GHG emissions.

Table 19. GDP (at market prices) at market prices adjusted to 2000 price level – Historical Data

	Historical Data					
	2000	2001	2002	2003	2004	2005
GDPmp (Millions of Euros 2000)	122 270	124 735	125 687	124 279	125 624	126 046
		2000-2001	2001-2002	2002-2003	2003-2004	2004-2005
Annual growth rates or annual averages (%)		2.0	0.76	-1.12	1.08	0.34

Source: IAa, 2006

Table 20. GDP (at market prices) at market prices adjusted to 2000 price level - 2005-2010 Scenario

	Projection Data					
	2005	2006	2007	2008	2009	2010 (a)
GDPmp (Millions of Euros 2000)	126 046	127 432	129 726	132 839	136 824	140 929
		2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
Annual growth rates or annual averages (%)		1.10	1.80	2.40	3.00	3.00

Source: IAa, 2006

Table 21. GDP (at market prices) at market prices adjusted to 2000 price level - 2010-2025 Scenarios

	Projection Data			
	High Scenario		Low Scenario	
	2015	2020	2015	2020
GDPmp (Millions of Euros 2000)	173 699	211 738	162 584	185 208
	2010-2015	2015-2020	2010-2015	2015-2020
Annual growth rates or annual averages (%)	4.27	4.04	2.90	2.64

Source: IAa, 2006

4.1.1 Projection Model for the Energy Sector

For the purpose of emissions projections, the Energy sector has been organised in energy demand sub-sectors (including Industry, Construction and Public Works; Agriculture, Forestry and Fisheries; Residential and Services) and energy supply sub-sectors.

a) Energy demand sub-sectors

The modelling of energy demand by the Industry, Construction and Public Works, and Agriculture, Forests and Fisheries sub-sectors follows a bottom-up approach, similar to the methodology adopted for the remaining energy demand sub-sectors. Final energy needs, such as heat, steam, fuel and electricity, are estimated from activity scenarios, with the added value for each sector being the proxy variable for linking economic activity to energy consumption.

The trend in efficiency of energy transformation and the competition among types of final energy is informally taken into account using technology and energy price scenarios. With regard to energy intensity trends (Annex 3, Table 59) in the reference scenario, the considered indices are based on the central technology scenario, with improvements deriving from expected technical progress rather than as the outcome of direct and indirect emission reduction policies. The model was calibrated for 2000, while for 2005 the indices were extrapolated from the trend in energy consumption observed until 2004.

The GHG emissions from Industry (including extractive industry, civil construction and public works) and Agriculture, Forestry and Fisheries are estimated from the energy demand scenarios or production levels, and take into account the standard emission factors by type of energy, technology and process (as used in the national GHG emissions inventory).

For combustion in the Residential and Services sectors (Other sectors), the modelling of energy demand has been carried out specifically in each sub-sector, following a simulation methodology that has been traditionally used for long-term studies both at the EU level and in Portugal. This methodology is based on the knowledge of a wide set of variables or indicators, which allow for the characterisation of the initial situation, as well as projecting energy demand from demographic, economic, social, technology and energy trends.

Energy demand in the Residential sub-sector is simulated in terms of final energy, by disaggregating the needs of households according to: (i) indoor heating and cooling; (ii) cooking; (iii) hot water; (iv) specific electricity. Energy demand for each final use is calculated in two stages. In the first phase, the model simulates the trend in final energy use in each consumption category, as a function of demographic and socio-economic variables such as total population, number of households and comfort conditions of families. At a second stage, the model determines final energy demand for each consumption category, taking into account the trend in a set of socio-economic, technological, energy and environmental variables (purchasing power of families, prices of different energy products, technical standards for buildings and equipment, technological progress, introduction of new energy products, among others).

In the Services sub-sector, energy demand is simulated in a similar fashion, but based on socio-economic indicators such as GVA and number of employees rather than demographic variables. Final energy consumption is simulated considering the following applications: (i) heat (bundling indoor heating, hot water and cooking); (ii) indoor cooling; (iii) specific electricity (including public lighting, ventilation and other uses). The model then simulates final energy consumption from this estimate, taking into account a set of socio-economic, technical, energy and environmental variables.

Future GHG emissions are projected from fuel consumption estimates in the different energy demand sub-sectors, taking into account the emission factors for each energy category as used in the national inventory.

b) Energy production sub-sectors

For the energy production sub-sectors, the simulation of energy consumption is based on energy demand simulation results and on estimates of internal consumption and losses in transport and distribution activities.

New scenarios for electricity demand have been used in the estimation of GHG emissions trends. The scenarios have also been used in the estimation of electricity generation needs and the respective configuration of the national electricity production system. Estimates of fossil fuel consumption in the different electricity production systems (namely coal, fueloil and natural gas power stations) and emission factors supplied by the Institute of the Environment (see NIR) have made the assessment of future GHG emissions in this sector possible.

Emissions estimates for the oil-refining sector were based, as in the electricity production sector, on the new energy demand trend scenarios, assuming that national refineries operate up to their full capacity. These new final energy consumption scenarios and the sectoral assumptions enabled the estimation of processed oil products and the use of national refining plants capacity. Fuel consumption estimates for different oil products processing units have been used to assess future GHG emissions, using emission factors supplied by the Institute of the Environment.

Emission estimates for other energy industries are focused on transport, distribution and natural gas storage activities.

4.1.2 Projection Model for the Transport Sub-sector

The GHG emissions projections for the Transport sub-sector are based on historical emissions estimates from national inventories (1990-2004), macro-economic growth indicators, and emission reductions from the implementation of sectoral policies and measures.

Projections for energy consumption related to land transport (2005-2020) are based on estimates of the national car fleet, intensity of mobility (pkm/pax and tkm/GDP) and in modal breakdown quotas.

The estimates for the period 2004-2020 are based on the trend observed from 1990-2003 and on the forecast GDP (high and low scenarios for the period 2010-2020[70]). This economic growth differentiation is only considered for land transport (road and railway) and water passenger transport.

As such, emissions projections under the reference scenario assume:

- a continuation of the trend[71] observed for the different transport services, both in terms of supply and demand; and
- the positive environmental impacts of measures in the reference scenario adjusted to reflect positive or negative shifts from target as verified in the 2004 monitoring exercise of the implementation of domestic policies and measures (see Chapter 3).

With regard to land transport and water passenger transport, the projection for passenger volume was achieved by combining national and European mobility indices (pkm/inhabitant) (Eurostat, 2004). Growth in mobility indices relative to 2000 has been projected at 23% to 2010 and 47% to 2020, under all of the scenarios considered.

In the high scenario, the modal breakdown projected for each of the transport services was obtained by continuing the trend for the period 1990-2003. Accordingly, the estimate of public transport's modal share (pkm/pkm) was of 13.7% in 2010 and 11.5% in 2020, against the 15.3% estimated for 2003. This estimate is correlated with the rate of motorization, which is in turn determined by the sales volume of light passenger vehicles[72] in this scenario. Motorization is estimated at 525 vehicles per 1000 inhabitants in 2010 and is expected to grow to 575 vehicles by 2020.

The public transport's share in the low scenario is estimated at 14.2% by 2020 due to a more conservative estimate of light passenger vehicles. The projected motorization rate under this scenario is of 565 vehicles/1000 inhabitants by 2020.

The technology structure of the car stock in 2020 is as projected in the reference bibliography[73]. The age structure of the national vehicle fleet, a factor of car sales and the vehicle-decommissioning rate, was calibrated using information from the Portuguese Automotive Trade Association (ACAP), the Portuguese Insurance Institute and the Portuguese Insurers Association.

Projections developed in PNAC 2006 regarding mobility, energy consumption and GHG emissions for this sector can be seen in Table 55 and Table 60 through to Table 65 in Annex 3.

[70] A single economic growth scenario is considered in the period 2004-2010.

[71] Estimated from the variables measured in the period 1990-2004.

[72] Includes light passenger vehicles and light freight vehicles (<3.5 t) used in passenger transport.

[73] André *et al.*, 1999. *Driving statistics for the assessment of pollutant emissions from road transport. MEET Project - Contract N° ST-96-SC.204. Methodologies for estimating air pollutant emissions from transport. Task 2.1 : Driving statistics for emission modelling*. Deliverable N° 15 - Public dissemination. Project funded by the European Commission under the Transport RTD. Programme of the 4th framework programme. INRETS Report LTE 9906. February 1999.

Projections for freight transport by road and railway derive from indexing the variation in aggregate freight transported to the variation in GDP. A growth in freight transport (tkm) of 23% by 2010 and 47% by 2020 is expected for any of the scenarios under consideration, relative to 2000.

A rigorous GHG emissions projection for maritime transport (passenger and freight) has not been possible due to the absence of projections for domestic traffic to 2010 and 2020. As such, and considering the relative historical stability of domestic traffic and associated energy consumption, future emissions were assumed to remain in line with the 5-year average for the period 1999-2003; no distinction was made between high and low scenarios to 2020.

In relation to air transport (passenger and freight), projections are based on growth forecasts for national air traffic as estimated by the Aéroport de Paris in the context of a study on the localization of the New Lisbon Airport.

4.1.3 Projection Model for Fluorinated Gases

Fluorinated gases (or F-gases) refer to hydrofluorocarbons (HFC), the perfluorocarbons (PFC) and sulphur hexafluoride (SF_6). In Portugal, these emissions originate from:

- HFC: leaks in the production, operation and decommissioning of air conditioning equipment, foam blowing, fire retardant equipment and inhalators; and
- SF6 : losses in electricity distribution systems, circuit breakers and metal-clad substations.

The projection of emissions from fixed and mobile cooling systems was calculated using equipment base load values (by refrigerant gas) and a leakage rate which varies as a function of the equipment's lifecycle stage: assembly, use or decommissioning. Calculations for fire extinguishers were based on the annual sales of HFC for fire retardants, subtracted by the HFC already used to recharge the equipments, and increased by the amounts still present in equipment removed from the market. In the case of foams, the estimates include HFC used in blowing, subject to a specific emission factor for the first and following years. For open cell foams, emissions simply equate to the amount of gas used in the blowing process, a methodology identical to that of the inhalators.

4.1.4 Projection Model for the Agriculture and Livestock Sector

Emissions projections for the agriculture and livestock sector were based on the number of livestock for 2005 and 2010 supplied by the Food and Agriculture Planning and Policy Office (GPPAA) of the Ministry of Agriculture, Rural Development and Fisheries. Projections to 2020 were based on the long run projection of selected agricultural variables for the European Environmental Agency[74] study, which is based on the CAPSIM model (Common Agricultural Policy Simulation Model).

Projections of agricultural areas for 2005 and 2010 were supplied by GPPAA, while those for 2020 were extrapolated from the variation between 2005 and 2010. For crops not subject to trend estimates by GPPAA, the agricultural areas used (for 2005, 2010 and 2020) were assumed to remain constant to those observed in 2000 (Annex 3, Table 56).

Projections for agricultural production in 2020 were calculated on the assumption of proportionality between production areas under cultivation.

[74] Information at http://www.eurocare-bonn.de/profrec/eea_outl/eea_outl_e.htm

The projection to 2010 and 2020 for "Nitrogen applied to synthetic fertilizers", estimated at 150 000 t, was obtained from the trend in the use of nitrogen in synthetic fertilisers during the period 1990-2004, as well as the trend in areas under cultivation and expected agricultural practises.

4.1.5 Projection Model for Land Use, Land Use Change and Forestry

The areas occupied by each type of forest settlement in 2010 and 2020 were estimated by interpolation, considering the targets for 2025 and the Regional Plans of Forestry Planning (PROF) (currently subject to public consultation and under the responsibility of Directorate-General for Forestry – DGRF). New forested areas were calculated by species, to 2010 and 2020, based on estimates of total forested area, and assuming consistent deforestation rates and annual harvested or burnt areas.

4.1.6 Projection Model for the Waste Sector

The reference scenario for the trend in Municipal Solid Waste (MSW) generated is based on the Strategic Plan for Municipal Solid Waste (PERSU) (Decree-Law 310/95, of 20 November). Progress towards targets was re-evaluated in the case of the National Strategy for Reduction and Landfill Disposal of Biodegradable Municipal Waste (BMW) (Decree-Law 152/2002, of 23 May) and the recovery of packages and packaging waste (Decree-Law 366-A/97, of 27 July).

The extension of the projection period until 2020 was based on a variable MSW production rate (adapted, taking into consideration data available up to 2004), similar to that defined in the National Strategy for BMW, which shows a decreasing trend. The MSW production and management scenario until 2020 is shown in Annex 3, Table 66.

Data for the biogas management scenario (Annex 3, Table 68), estimated in 2001, was updated for each MSW management system, maintaining the following assumptions:

- coverage by MSW management systems with biogas recovery/burning (installed, or to be installed) was determined by population density (December 2004 data);
- six management systems were identified with simultaneous biogas recovery from previous waste dumps and from current landfills; and
- in the remaining MSW management systems, the burning/recovery of biogas occurs only in the respective landfill(s).

The projection methodology for Industrial Wastes (RI) includes organic RI disposed of in landfill and considers an annual growth rate of industrial production and the implementation of reduction methodologies (method used in the National Plan for Prevention of Industrial Waste – PNAPRI) (Annex 3, Table 69.

In the absence of projections on the amounts of type III and IV[75] Hospital Wastes (HW), the HW incineration scenario was estimated on the basis of assumptions for MSW growth rates.

[75] Types of hospital waste subject to incineration.

Projections for GHG emissions for the domestic wastewater sub-sector are based on wastewater treatment indices for the period 1990-1999, provided by the National Water Institute (INAG) (Annex 3, Table 70). From 2000 onwards, estimates have been based on the following assumptions:

- a target of 90% of the population served with sewerage and treatment systems, by 2007, as defined in the National Water and Regional Development Plan;
- maintenance of loads treated by systems such as: septic tanks, primary treatment, biodiscs, percolation processes. A relative decrease is expected by 2010/20 as there will be no further construction of such systems in the future;
- association between the remaining loads generated/treated and the increase in treatment at more recent secondary and tertiary systems (activated sludge, oxidation pits, others). These treatment systems, which served 0% of the population in 1990 as they are considered recent and advanced, will accommodate the remaining percentage of treatments in order to meet the 90% target by 2007; and
- biogas burning/recovery in sludge treatment/digestion systems built after 2000.

A projection of generated loads was based on PNAC's demographic trend scenario and maintained per capita organic loads (21.9 kg CBO_5/inhab.year). The calculations of these parameters are shown in Annex 3, Table 71.

From 2003 onwards, industrial wastewater projections were based on the GVA growth rates of the industrial sectors including the various sub-activities under consideration. This is due to the high level of disaggregation of industrial activities considered in this sub-sector (Annex 3, Table 72 through to Table 74) and the different sources of the background data.

4.2 Projections by Sector

Table 22 and Figure 40 show the trend in GHG emissions (1990-2010) estimated for the reference and with additional measures scenarios.

According to the projections for the reference scenario, it is estimated that, by 2010, Portugal's GHG emissions will total to 84 608 kt CO_2e (with LULUCF). The sector with most significant representation is Energy, with 65 741 kt CO_2e. Energy industries and Transport sub-sectors have the largest contributions, with 23 146 kt CO_2e and 21 151 kt CO_2e, respectively, corresponding to approximately 53% of the national total.

The trend of the "diffuse" sectors is noteworthy: the Transport sub-sector is expected to grow by over 100%, and the Residential and Services sub-sector, by 75% compared to 1990. The Waste sector contribution is expected to decrease by 14% compared to the base year, due to improved management standards of municipal solid waste (Landfill and Packaging Directives), as well as management of domestic and industrial wastewater.

The weight of each sector in the national GHG emissions balance is also expected to change between 1990 and 2010, with the Energy sector's share growing from 67% to 75%, while the share for Industrial Processes sector should remain at 8%. The Agriculture sector's contribution is expected to decrease from 13% to 10% and the Waste sector from 12% in 1990 to 7% by 2010.

GHG emissions reduction potential from additional measures totals 3687 kt CO_2e/year, resulting in total emissions (without LULUCF) of 80 920 kt CO_2e by 2010, under the with additional measures scenario. This value is 5% higher than the assigned amount under the Kyoto target (77 194 kt CO_2e).

The general emissions trend described for the reference scenario remains consistent under the with additional measures scenario, with policies and measures affecting the Energy industries and Transport sub-sectors and Agriculture sector resulting in expected emissions reductions of 4%, 3% and 5%, respectively, in relation to the reference scenario. Furthermore, the national sink capacity, relative to the reference scenario, is expected to increase by 39%.

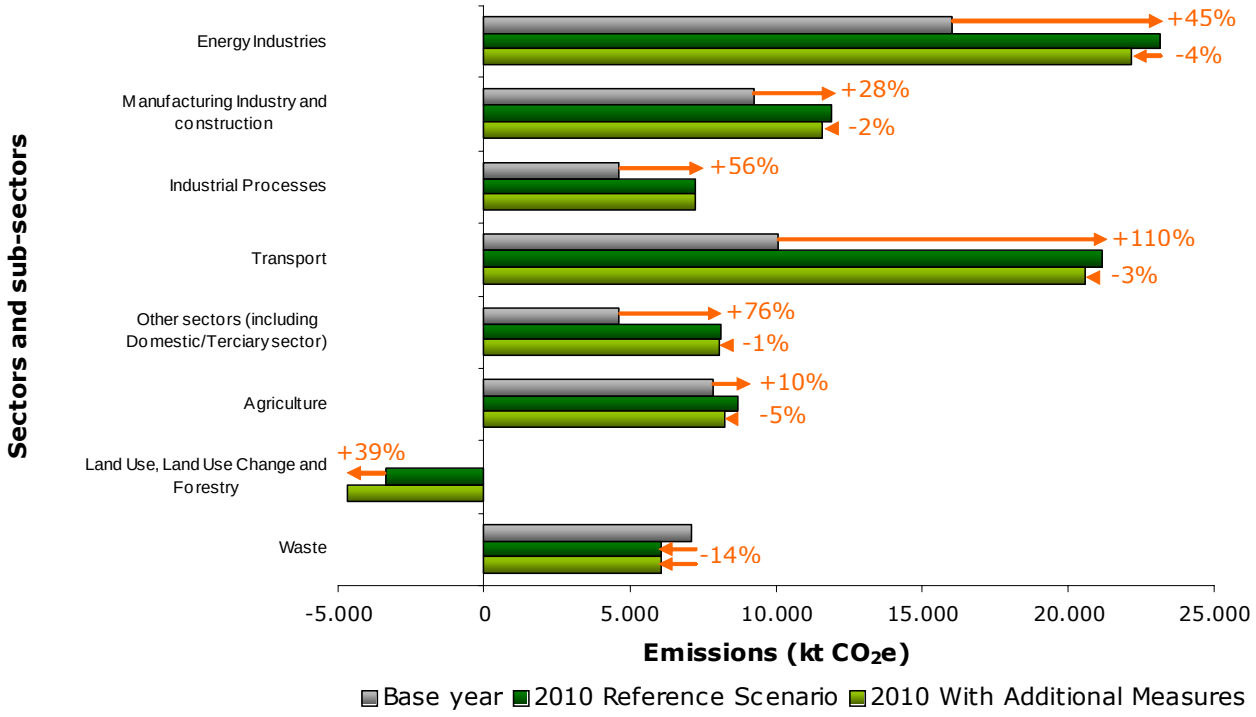

Figure 40. Trend in GHG (1990-2010) estimated for the reference scenario and with additional measures
Source: IAa, 2006

Table 22. Balance of national GHG emissions in the reference scenario and with additional measures scenario

IPCC Sector	Historical Emissions (Kt CO_2e)			Reference Scenario (Kt CO_2e)			Δ Base Year - 2010 (Reference Scenario)	With Additional Measures Scenario (kt CO_2e)			Δ 2010 with additional measures versus Base Year
					Low	High			Low	High	
	Base Year	2000	2004	2010	2020	2020		2010	2020	2020	
Total[76]	**60 783**	**82 178**	**84 546**	**84 608**	**95 995**	**102 381**	**39.2%**	**80 920**	**94 013**	**99 709**	**33.1%**
Distance to Kyoto Target[77]	**77 194**	**-**	**-**	**84 608**	**-**	**-**	**9.6%**	**80 920**	**-**	**-**	**4.8%**
1. Energy	**40 169**	**59 189**	**60 803**	**65 741**	**73 837**	**80 223**	**63.7%**	**63 761**	**72 363**	**78 059**	**58.7%**
A. Combustion Fuel	39 944	58 461	59 554	64 302	72 070	78 211	61.0%	62 336	70 488	76 056	56.1%
1. Energy industries	16 010	20 864	21 370	23 146	24 990	28 209	44.6%	22 161	25 260	28 036	38.4%
Electricity and heat	14 014	18 404	18 872	19 879	21 547	24 766	41.9%	18 894	21 852	24 593	34.8%
Refining	1920	2404	2499	3267	3443	3443	70.1%	3267	3408	3443	70.1%
Manufacturing of solid fuels	75	56	0	0	0	0	-100.0%	0	0	0	-100.0%
2. Manufacturing industry[78] and construction	9263	11 884	10 821	11 902	13 693	15 155	28.5%	11 602	13 354	14 797	25.2%
3. Transport	10 052	19 383	20 043	21 151	24 213	24 860	110.4%	20 543	23 605	24 251	104,4%
Civil aviation	167	367	405	462	620	632	177.3%	462	620	632	177.3%
Road	9459	18 671	19 333	20 397	23 310	23 944	115.6%	19 789	22 702	23 336	109.2%
Railway	185	141	92	85	75	76	-54.0%	85	75	76	-54.0%
Maritime	242	204	213	207	207	207	-14.4%	207	207	207	-14.4%
4. Other sectors	4610	6329	7320	8104	9174	9988	75.8%	8031	8270	8970	74.2%
Commerce/ Tertiary sector	747	2208	3510	4343	5354	6073	481.5%	4284	4521	5128	473.6%
Domestic	2050	2745	2665	2863	2768	2829	39.7%	2849	2697	2756	39.0%
Agriculture/Forestry/Fisheries	1814	1376	1144	897	1052	1086	-50.5%	897	1052	1086	-50,5%
B. Fugitive emissions from fuels: oil and natural gas products	225	728	1249	1438	1768	2012	539%	1425	1875	2004	533.0%

[76] Including all the relevant values for the purpose of assessing compliance with quantitative emissions reduction objectives under the Kyoto Protocol and the Burden Sharing Agreement.

[77] In accordance with the report submitted to the European Commission on April 2006 (IAc, 2006), calculated following Art. 3(7) of the Kyoto Protocol.

[78] Includes processing and combustion emissions.

IPCC Sector	Historical Emissions (Kt CO_2e)			Reference Scenario (Kt CO_2e)			Δ Base Year - 2010 (Reference Scenario)	With Additional Measures Scenario (kt CO_2e)			Δ 2010 with additional measures versus Base Year
					Low	High			Low	High	
	Base Year	2000	2004	2010	2020	2020		2010	2020	2020	
Total[76]	**60 783**	**82 178**	**84 546**	**84 608**	**95 995**	**102 381**	**39.2%**	**80 920**	**94 013**	**99 709**	**33.1%**
Distance to Kyoto Target[77]	**77 194**	**-**	**-**	**84 608**	**-**	**-**	**9.6%**	**80 920**	**-**	**-**	**4.8%**
2. Industrial Processes	**4626**	**6038**	**7035**	**7204**	**7881**	**7881**	**55.5%**	**7204**	**7881**	**7881**	**55.5%**
A. Mineral products	3385	4360	4184	4087	4184	4184	20.7%	4087	4184	4184	20.7%
B. Chemical industry	1209	1485	2453	2347	2347	2347	94.1%	2347	2347	2347	94.1%
C. Metal production	29	52	38	21	21	21	-29.4%	21	21	21	-29.4%
D. Others	0	0	0	1	1	1	16.2%	1	1	1	16.2%
F. F-gases consumption SF6, HFC, PFC)	9	140	358	748	1328	1328	7968.7%	748	1328	1328	7968.7%
3. Solvents and Other Product Use	**220**	**290**	**320**	**290**	**290**	**290**	**32.0%**	**290**	**290**	**290**	**32.0%**
4. Agriculture	**7878**	**8387**	**8445**	**8649**	**8372**	**8372**	**9.8%**	**8220**	**7865**	**7865**	**4.3%**
A. Enteric fermentation	2622	2996	3012	3119	2927	2927	19.0%	3119	2927	2927	19.0%
B. Manure management	1740	1796	1735	2099	2032	2032	20.7%	1671	1525	1525	-4.0%
C. Rice culture	256	180	194	179	203	203	-29.9%	179	203	203	-29.9%
D. Agricultural soils	3225	3383	3472	3217	3175	3175	-0.2%	3217	3175	3175	-0.2%
F. Burning of agricultural residues	35	32	32	33	34	34	-6.0%	33	34	34	-6.0%

IPCC Sector	Historical Emissions (Kt CO_2e)			Reference Scenario (Kt CO_2e)			Δ Base Year - 2010 (Reference Scenario)	With Additional Measures Scenario (kt CO_2e)			Δ 2010 with additional measures versus Base Year
					Low	High			Low	High	
	Base Year	2000	2004	2010	2020	2020		2010	2020	2020	
Total[76]	**60 783**	**82 178**	**84 546**	**84 608**	**95 995**	**102 381**	**39.2%**	**80 920**	**94 013**	**99 709**	**33.1%**
Distance to Kyoto Target[77]	**77 194**	**-**	**-**	**84 608**	**-**	**-**	**9.6%**	**80 920**	**-**	**-**	**4.8%**
5. Land Use Change and Forestry	**3531**[79]	**-4084**[80]	**-2742**[81]	**-3355**	**ND**	**ND**	-	**-4655**	**ND**	**ND**	-
Deforestation (Art. 3(7) of Kyoto Protocol)	822	-	-	-	-	-	-	-	-	-	-
Art. 3(3) of Kyoto Protocol	-	-	-	-3355	ND	ND	ND	-3355	ND	ND	ND
Deforestation	-	-	-	388	ND	ND	ND	388	ND	ND	ND
Afforestation / Reforestation	-	-	-	-3743	ND	ND	ND	-3743	ND	ND	ND
Art.º 3(4) of Kyoto Protocol	-	-	-	ND	ND	ND	ND	-1300	ND	ND	ND
Forest management	-	-	-	ND	ND	ND	ND	-800	ND	ND	ND
Cropland management / Grazing land management	-	-	-	ND	ND	ND	ND	-500	ND	ND	ND
6. Waste	**7061**	**8274**	**7944**	**6080**	**5614**	**5614**	**-13.9%**	**6080**	**5614**	**5614**	**-13.9%**
A. Solid waste disposal on land	3892	4788	4756	3009	2411	2411	-22.7%	3009	2411	2411	-22.7%
B. Wastewater handling	3158	3095	2829	2548	2745	2745	-19.3%	2548	2745	2745	-19.3%
C. Waste incineration	10	390	357	523	459	459	4899.9%	523	459	459	4899.9%
D. Others	1	0	1	0	0	0	-100.0%	0	0	0	-100.0%

Source: IAa, 2006 and IAb, 2006

[79] Not included in total.

[80] Not included in total.

[81] Not included in total.

Figure 41 shows the disaggregated sectoral structure for the Energy sector, in 1990 and in the reference scenario.

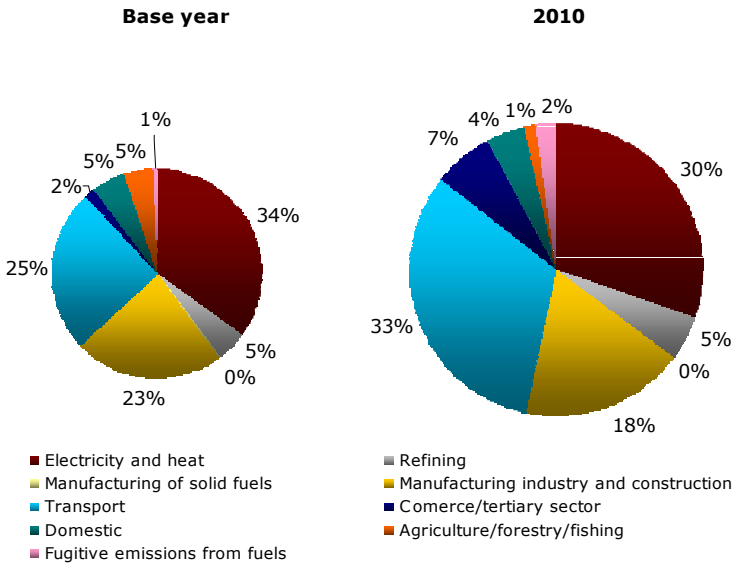

Figure 41. Sectoral structure of GHG emissions in 1990 and in 2010, disaggregated for the Energy sector[82]
Source: IAa, 2006

4.2.1 Projections by Gas

Table 23 through to Table 26 systematise the trend in emissions for each of the GHG in the reference scenario and with additional measures.

The Energy sector has the largest contribution to CO_2 emissions, with a maximum of 63 842 kt CO_2 by 2010 in the reference scenario. Emissions are reduced by 2.5% with additional measures.

The Waste and Agriculture sectors are the main sources of CH_4. From its maximum value in 2000 (349 kt CH_4), Waste sector emissions will decrease to a minimum of 213 kt CH_4 in 2020 under both scenarios. A slight decrease in emissions was observed in the period from 2000 to 2004. This trend is expected to continue and intensify beyond 2010 (emissions reductions of 9% and 12% under the reference scenario and with additional measures, respectively) to 2020 due to reductions from the Agriculture and Waste sectors and in spite of an expected increase from the Energy sector.

The Agriculture sector is the principal source of N_2O. No significant variation is expected between the reference scenario and with additional measures scenario for this gas, which emissions show a growth trend in particular due to the Energy and Waste sectors.

Additional information can be obtained from PNAC.

[82] No changes are observed in the sectoral structure of GHG emissions under the with additional measures scenario, relative to the reference scenario

Table 23. Historical and projected emissions of CO_2 in the reference scenario and with additional measures

IPCC Sector	Historical Emissions (Kt CO_2)			Reference Scenario (kt CO_2)			Δ 1990-2010 (Reference Scenario)	With Additional Measures Scenario (kt CO_2)			Δ 1990-2010 (with Additional Measures)
					Low	High			Low	High	
	1990	2000	2004	2010	2020	2020		2010	2020	2020	
Total (with LULUCF)	**46 727**	**59 533**	**62 842**	**66 721**	**73 804**	**79 881**	**43%**	**65 120**	**72 593**	**78 124**	**39%**
Total (without LULUCF)	**43 366**	**63 763**	**65 705**	**70 464**	**78 130**	**84 207**	**62%**	**68 863**	**76 918**	**82 450**	**59%**
1. Energy	39 087	57 660	58 996	63 842	71 471	77 548	63%	62 241	70 259	75 791	59%
2. Industrial Processes	4049	5452	6059	5848	5945	5945	44%	5848	5945	5945	44%
3. Solvents and Other Product Use	220	290	320	290	290	290	32%	290	290	290	32%
4. Agriculture	0	0	0	0	0	0	0%	0	0	0	0%
5. Land Use, Land Use Change and Forestry	3362	-4230	-2863	-3743	-4325	-4325	-	-3743	-4325	-4325	-
6. Waste	10	361	330	484	424	424	4840%	484	424	424	4840%

Source: IAa, 2006 and IAb, 2006

Table 24. Historical and projected emissions of CH_4 in the reference scenario and with additional measures

IPCC Sector	Historical Emissions (Kt CH_4)			Reference Scenario (Kt CH_4)			Δ 1990-2010 (Reference Scenario)	With Additional Measures Scenario (kt CH_4)			Δ 1990-2010 (with Additional Measures)
					Low	High			Low	High	
	1990	2000	2004	2010	2020	2020		2010	2020	2020	
Total (with LULUCF)	**541.87**	**593.21**	**588.85**	**495.42**	**478.09**	**489.88**	**9%**	**475.26**	**460.23**	**466.08**	**12%**
Total (without LULUCF)	**534.56**	**586.89**	**583.64**	**495.42**	**478.09**	**489.88**	**7%**	**475.26**	**460.23**	**466.08**	**11%**
1. Energy	26.88	29.97	40.83	38.1	50.89	62.73	-42%	37.56	56.31	62.16	-40%
2. Industrial Processes	0.43	0.54	0.62	0.52	0.52	0.52	-21%	0.52	0.52	0.52	-21%
3. Solvents and Other Product Use	0.00	0.00	0.00	0.0	0.0	0.0	00%	0.00	0.00	0.00	0%
4. Agriculture	193.89	207.56	208.58	221.58	213.22	213.16	-14%	201.96	189.94	189.94	-4%
5. Land Use, Land Use Change and Forestry	7.31	6.31	5.22	0.00	0.00	0.00	-	0.00	0.00	0.00	-
6. Waste	313.36	348.82	333.61	235.22	213.46	213.46	25%	235.22	213.46	213.46	25%

Source: IAa, 2006 and IAb, 2006

Table 25. Historical and projected emissions of N_2O in the reference scenario and with additional measures

IPCC Sector	Historical Emissions (Kt N_2O)			Reference Scenario (Kt N_2O)			Δ 1990-2010 (Reference Scenario)	With Additional Measures Scenario (kt N_2O)			Δ 1990-2010 (with Additional Measures)
					Low	High			Low	High	
	1990	2000	2004	2010	2020	2020		2010	2020	2020	
Total (with LULUCF)	**17.34**	**19.24**	**20.12**	**20.48**	**20.96**	**21.22**	**18%**	**20.47**	**20.99**	**21.19**	**18%**
Total (without LULUCF)	**17.29**	**19.20**	**20.08**	**20.48**	**20.96**	**21.22**	**18%**	**20.47**	**20.99**	**21.19**	**18%**
1. Energy	1.67	2.90	3.06	3.54	4.19	4.44	112%	3.54	4.21	4.41	112%
2. Industrial Processes	1.83	1.40	1.95	1.93	1.93	1.93	5%	1.93	1.93	1.93	5%
3. Solvents and Other Product Use	0.00	0.00	0.00	0.00	0.00	0.00	0%	0.00	0.00	0.00	0%
4. Agriculture	12.28	13.00	13.11	12.89	12.57	12.57	5%	12.89	12.57	12.57	5%
5. Land Use, Land Use Change and Forestry	0.05	0.04	0.04	0.00	0.00	0.00	-	0.00	0.00	0.00	-
6. Waste	1.52	1.90	1.96	2.12	2.28	2.28	39%	2.12	2.28	2.28	39%

Source: IAa, 2006 and IAb, 2006

Table 26. Historic and projected emissions for F-gases in the reference scenario and with additional measures

IPCC Sector	Historic emissions (Kt CO_2e)			Reference Scenario (Kt CO_2e)			Δ 1995-2010 (Reference Scenario)	With Additional Measures Scenario (kt CO_2e)			Δ 1995-2010 (with Additional Measures)
					Low	High			Low	High	
	1995	2000	2004	2010	2020	2020		2010	2020	2020	
Consumption of F-gases (SF6, HFC, PFC)	9	140	359	748	1328	1328	37 300%	748	1328	1328	37 300%

Source: IAa, 2006 and IAb, 2006

4.3 Analysis of the Contribution of Domestic Policies and Measures Towards the Compliance with the Kyoto Target

In light of the PNAC 2006 emissions projections for 2010, which take into consideration the reference scenario as well as the emissions reduction potential from additional policies and measures, it is possible to assess how Portugal will achieve its quantitative GHG emissions limitation target for the first commitment period of the Kyoto Protocol, in the frame of the EU Burden Sharing Agreement. This commitment corresponds to a limitation of GHG emissions in the order of 385 970 450 kt CO_2e (Assigned Amount Units) in the five year period (2008-2012), equivalent to 77 194 kt CO_2e/year.

In line with these results, the following are noted:

- The net GHG emissions balance in the reference scenario (including afforestation, reforestation and deforestation activities under art. 3(3) of the Kyoto Protocol) is of 84 608 kt CO2e, about 10% above the emissions reduction target (7.4 Mt CO2e gap).
- The net balance of emissions, considering the additional policies and measures under the PNAC (including those activities under art. 3(4) of the Kyoto Protocol) is estimated at 80 920 kt CO2e. This entails a GHG emissions reduction potential of about 3.7 Mt CO2e/year, and demonstrates a capacity to achieve 50% of the referred deficit through domestic measures.

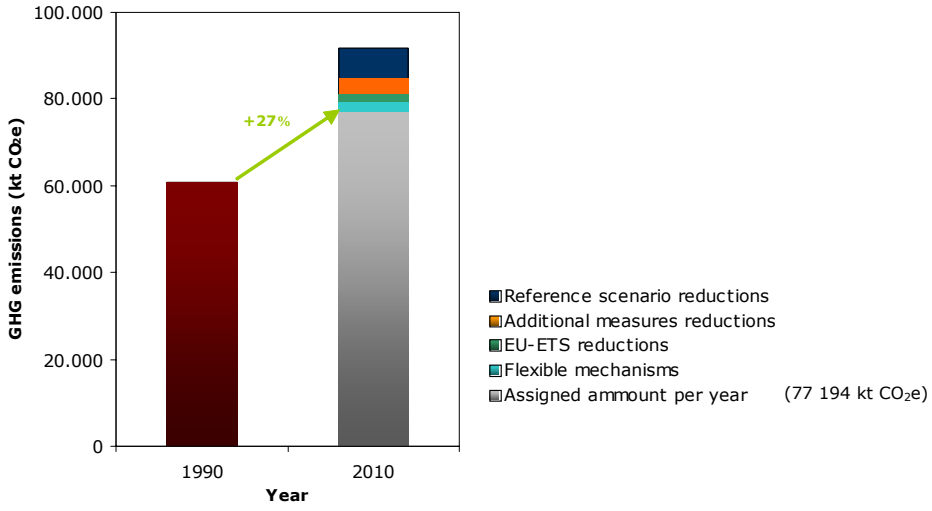

Figure 42. Compliance with the Kyoto target

Source: IAa, 2006

This 3.7 Mt CO_2e/year gap can be met through the EU-ETS and the acquisition of emissions reduction credits through the flexibility mechanisms of the Kyoto Protocol. As such, credits in the amount of 1.86 Mt CO_2e/year shall be acquired from the Kyoto Protocol's flexibility mechanisms, leaving to the operators of the EU-ETS an emissions reduction effort of 1.87 Mt CO_2e/year.

This demonstrates Portugal's effort in fully exploring the potential of emissions reduction, through a broad range of policies and measures, and by using market mechanisms as a tool to ensure an overall benefit in the most cost-effective manner, as foreseen under the Kyoto Protocol.

5 Impacts, Vulnerability and Adaptation

5.1 Climate Scenarios

The Climate Change in Portugal: Scenarios, Impacts, and Adaptation Measures (SIAM) project is the most comprehensive study on the impacts and vulnerability associated with climate change in Portugal. This study was based on future climate scenarios derived from atmosphere general circulation models, analysing its effects on a number of socio-economic sectors and biophysical systems including hydrological resources, coastal areas, energy sector, forests and biodiversity, fishing, agriculture and health. The first phase of this project examined mainland Portugal; a second phase extended the study to the autonomous regions of the Azores and Madeira.

The aim of this survey was to raise awareness of stakeholders involved with the climate change issue including central and local administrations, business, NGOs and the general public, of future climate scenarios and their impact on socio-economic sectors and biophysical systems in Portugal, as well as possible adaptation measures to mitigate the effects of climate change.

The different climate scenarios show significant change to the Portuguese climate. A systematic increase in temperature in the order of 3 ºC to 7 ºC is estimated for the summer season in continental Portugal, affecting in particular inland Northern and Central regions. Increased frequency and intensity of heat waves is also foreseen. In the islands, the temperature increase is estimated to be more moderate, in the order of 1ºC to 2ºC in the Azores and 2ºC to 3 ºC in Madeira.

As a result of a reduction of the rainy season, different scenarios forecast a reduction in annual rainfall in the continent by 20-40% of current levels. The majority of the models predict a moderate increase in rainfall in the North in the winter season for the period 2070-2099 relative to the baseline period of 1961-1990. Model projections are more variable for the Centre and South in the winter season within this same period. A generalised reduction in rainfall is projected, particularly in the spring and autumn.

A significant reduction (about 30%) in annual precipitation is also projected for Madeira during this period. In the Azores, changes are predicted in the annual rainfall cycle but without substantial impact on total precipitation.

The main impacts identified in the SIAM project include:

- probable changes in flood and drought regimes, as well as changes in the quality and availability of water;
- significant increase in the risk of fire hazards;
- considerable increase in air pollution levels and ecological disturbances, which may lead to significant changes in the dynamics of infectious disease transmission as well as regional variations in agricultural productivity;
- increase of the erosion processes and consequently of the flooded areas;
- reduction in the yield of irrigated crops.

Climate scenarios in mainland Portugal

Climate scenarios for continental Portugal were obtained in this study by using versions 2 and 3 of the regional model from the Hadley Centre (HadRM). These models offered a better spatial definition compared to other global models. Both HadRM2 and HadRM3 models offer a horizontal grid spacing of approximately 50 km. HadRM3 covers eastern regions of the North Atlantic (excluding Azores and Madeira) and continental Europe. Daily and monthly data from

several meteorological parameters simulated by HadRM2 and HadRM3 models served as a platform for the climate scenarios. Data for the HadRM2 and HadRM3 models were obtained from the scenario IS92a or SRES (Special Report Emission Scenarios) A2 and B2 scenarios, respectively. Data from two simulations were used in the IS92a scenario: a control simulation where the level of CO_2 was kept constant (323 ppm) and comparable to levels during 1961-1990, and a simulation with CO_2 concentrations increasing at a rate of 1% per year from 1990.

SIAM (first phase) applied the IS92a emissions scenario, which predicted a doubling of the concentration of CO_2 by the end of the 21st century relative to 1990. The new SRES scenarios consider a wider combination of factors than the IS92a scenarios in forecasting possible emissions trends. There are four SRES scenario families: A1 ("Global Economy" or "Comfort and Efficiency without Borders"), A2 ("Protectionism" or "Regional Self-sufficiency"), B1 ("Global Sustainability"), B2 ("Rural Sustainability" or "Back to Nature and the Community"), where A1 is subdivided in three groups, A1FI (Fossil Intensive), A1T (Predominantly non-fossil fuel) and A1B (Balanced).

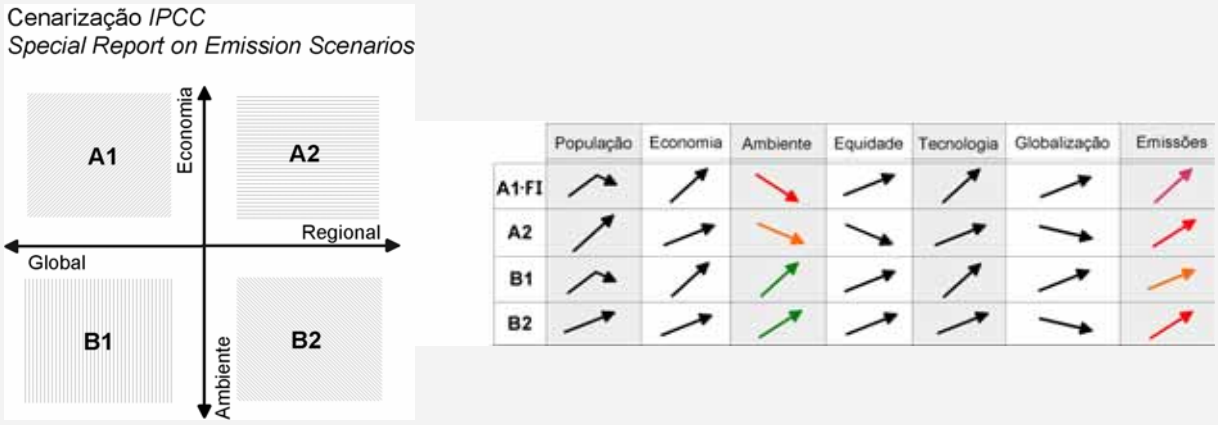

Figure 43. Long-term IPCC scenarios: SRES scenarios, dominated by governance type (horizontal axis) and predominant values (vertical axis) (left) and storylines of the SRES scenarios at a global level; FI is a variant of the A1 scenario (right)

Source: Santos et al., 2006

Atmospheric concentrations of CO_2 generated by the IS92a and different SRES scenarios are shown in Figure 44. By 2100, atmospheric CO_2 concentrations are projected to vary between 540 ppm (B1) to 970 ppm (A1F1), 90% to 250% above the respective concentration in 1750 (280 ppm). The IS92a scenario is used as an intermediate scenario (compared to SRES scenarios) with atmospheric CO_2 concentrations reaching 705 ppm by 2100. Projections (using various models) for the period 2070-2090 include an increase in air temperature, accompanied by a decrease in annual rainfall, except in a case where aerosol effects are considered. In general these models show deviations in air temperature varying between 3 ºC and 7 ºC in the western parts of the Iberian Peninsula.

The results of all simulations show a positive trend in the mean air temperature for the Iberian Peninsula in the 21st century. In 2100, air temperature deviations vary between 1.7 ºC and 7 ºC compared to the control simulation. Throughout the 20th century the models predict a small increase in the mean air temperature; this is particularly the case in the last quarter of a century, coinciding approximately with the latest period of local and global warming.

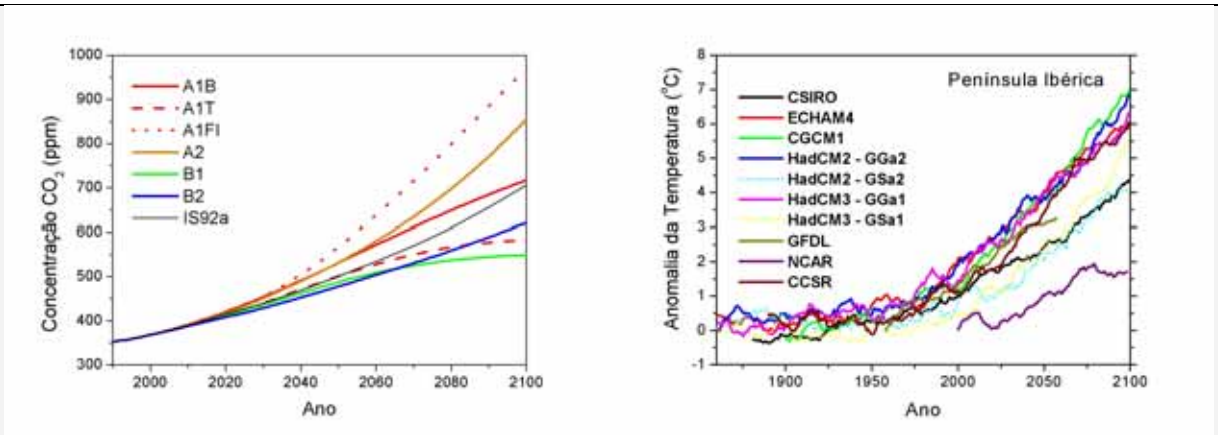

Figure 44. SRES scenarios for atmospheric CO_2 concentration (A1B, A1T, A1FI, A2, B1 and B2); and trends in mean air temperature deviations for the Iberian Peninsula using various atmosphere general circulation models (AGCMs), calculated from the difference in simulations of increased CO_2 concentration (scenario IS92a) and control simulations; moving average of 10 years applied to annual series

Source: Santos et al., 2006

Climate scenarios for the Azores and Madeira

The simple, stationary CIELO (*Clima Insular à Escala Local*) model was used for the Azores and Madeira. This model incorporates air temperature, pressure, rainfall and wind speed values observed in a reference station near sea level. Following altimetric correction, these values are used as a representation of the thermodynamic state of a nearly-saturated air particle over the ocean.

For the period 2070-2099, the A2 scenario predicts deviations in maximum temperature in the summer by +2 ºC in Madeira, whilst in the Azores the deviation is predicted to be moderately lower, between +1 ºC and +2 ºC. In the less extreme scenario of B2, both Madeira and Azores experience an increase in the maximum temperature in the summer between 1 ºC and 2 ºC.

The A2 scenario shows an increase in the minimum temperature in winter of approximately 2.5 ºC in Madeira and varying between 1.5 ºC and 2 ºC in the Azores. In the B2 scenario the increase in temperature is moderately greater than 1.5 ºC in Madeira and in the order of 1 ºC in the Azores. The most significant winter temperature deviations are projected for the African continent, not for the Iberian Peninsula as happened in the case of Summer temperature.

The A2 scenario forecasts, for 2070-2099, a slight increase of the winter's precipitation deviations in latitudes greater than 35 ºN, including the Azores, and a decrease in the precipitation observed below this latitude. Thus the model predicts a reduction of 20% in the winter precipitation for Madeira and an increase in the Azores precipitation of 10%. Still in the context of the A2 scenario, the summer precipitation deviation values are predominately negative in the Northeast Atlantic, with the exception of the Northern African coast and the Southern continental Portugal, where maximum precipitation levels increase significantly, by up to 90%. This exception also applies to the Western Mediterranean close to the Spanish coast. Madeira is located in a region where the summer precipitation deviation is positive, in the order of 40%. In contrast, the model predicts a loss in precipitation greater than 20% in the Azores summer.

In scenario B2, winter precipitation deviations for Madeira are negative and slightly more significant than those of scenario A2, whilst for the Azores they are comparable (positive). Madeira presents a more moderate increase in summer precipitation in scenario B2 (20%) compared to scenario A2, whilst the decrease in precipitation in the Azores region is between 10% and 20%, values lower than those projected under scenario A2.

5.2 Impacts and Vulnerability

5.2.1 Water Resources

Main impacts and vulnerabilities predicted by SIAM regarding hydrological resources include:

- a change in the seasonal distribution of river flows, concentrating in winter months, induced by similar distribution patterns of precipitation. This trend exacerbates the seasonal asymmetry in the availability of water in continental Portugal, with a tendency for a reduction in river flows in spring, summer and autumn. The relative magnitude of the impact of climate change on river flows increases from the North to the South of the country;
- depending on the scenario: (a) possibility of a reduction in the mean annual flow (in the most pessimistic scenario, a reduction is predicted for 2050 of between 10%, in the regions on the North of the Douro river, and 50% in the Algarve region; this tendency may be more pronounced by 2100 assuming that the levels of precipitation are reduced by 80% in the Algarve); (b) possibility of an increase in the annual mean flow between 20% and 40% by 2100 (according to scenarios HadCM3-B2a and HadRM2, respectively);
- an increase in the magnitude and frequency of floods, particularly in the North, due to the concentration of precipitation in the winter season, and a predicted increase in frequency of heavy rainfall;
- diminished water quality, particularly in the South region, as a result of a rise in temperature and a reduction in river flows in the summer season;
- sinking groundwater tables, especially in near-subsurface aquifers due to the expected reduction in the replenishing rate and the increase of the evaporation;
- a change in discharge flows from aquifers to rivers due to the expected reduction in replenishing rates;
- degradation of river ecosystems which are dependent on groundwater;
- reduction of the freshwater intake and an increase in saline contamination of coastal aquifers due to saline intrusion, consequence of a rise in sea level resulting from climate change-related increase in temperature;
- change in the level of vulnerability of aquifers to agriculture-related pollution due to changes in land use and agricultural practices.

5.2.2 Coastal Zones

The climatic changes occurring before the end of the 21st century will affect coastal zones mainly through changes in sea agitation and a rise in mean level of the sea.

It is predicted that a rise in sea level will primarily impact coastlines through increased coastal erosion, a rise in flood tide and, consequently, on the extent of flooding, accompanied by readjustments of small river ecosystems and an increase of marine influence on tidal basins (estuaries and lagoons) followed by changes in tidal regimes and eventually in the sediment balance.

These changes will have effects which are distinct and that have variable intensity on different areas of the coastline. These impacts on environmental, economic and social values and activities will depend on the physical and socio-economic make-up of each specific location.

5.2.3 Energy

The main impacts of climate change on the Energy sector are:

- Positive impacts:
  - projection of greater hydroelectric potential in the North;
  - reduced energy needs for water heating (for sanitation, swimming pools);
  - a greater attractiveness and effectiveness of solar energy systems.
- Negative impacts:
  - increased energy demand from air conditioning in residential as well as service buildings and transport owing to higher summer temperatures, despite better regulations and future technological improvements;
  - higher energy consumption resulting in a shift of the peak of energy consumption from winter to summer, placing a heavier burden on the electricity grid.

5.2.4 Human Health

Research undertaken in the context of SIAM on impacts on human health at regional and national levels, as well as consequences on tourism, suggest the following trends:

- rise in discomfort, morbidity and mortality associated with heat (as heat waves will be more frequent and of greater intensity);
- decrease in discomfort, morbidity and mortality associated with cold temperatures (due to moderate winters);
- increase in the prevalence of respiratory and cardiovascular disease (result of a deterioration in air quality);
- general increase in mortality and morbidity due to changes in mental health (associated to flooding, storms, drought and fire);
- increase in disease transmission through water and food (consequence of flooding, drought, higher temperatures and rise in sea levels);
- changes in the frequency and distribution of vector-borne and rodent-borne disease (due to higher temperature, drought, flooding and changes in humidity).

5.2.5 Agriculture

The impact of climate change on annual crop yields in continental Portugal is shown in Figure 45 to Figure 48. A decrease in all crop yields is considered, with the exception of pasture and forage crops.

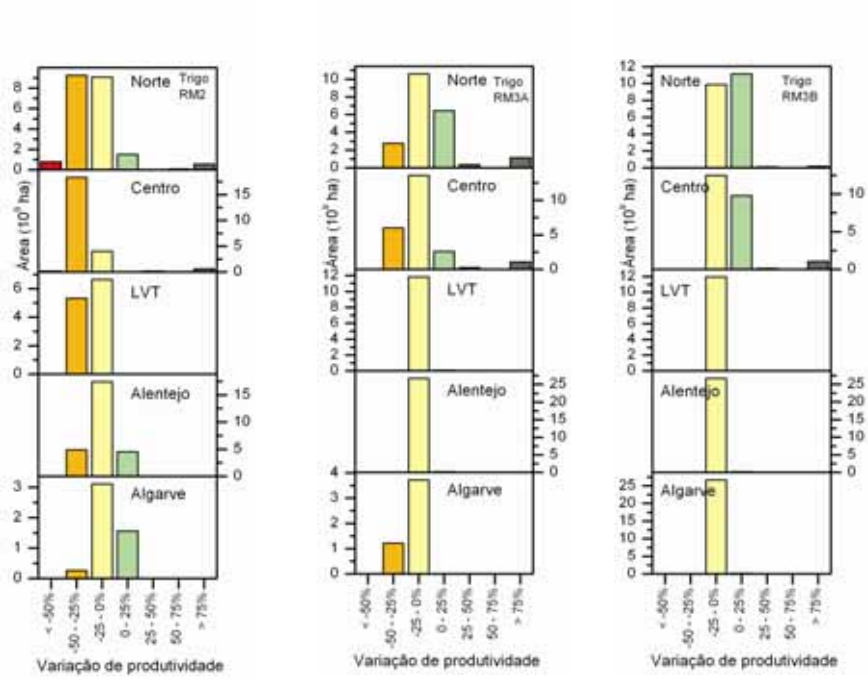

Figure 45. Differences in wheat production obtained from several model simulations
Source: Santos et al., 2006

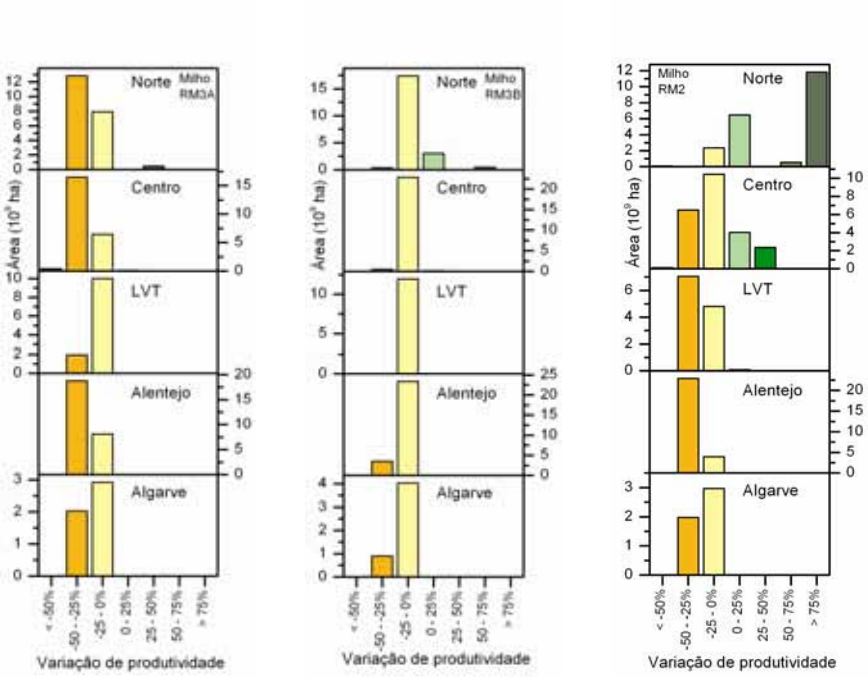

Figure 46. Differences in corn production obtained from several model simulations
Source: Santos et al., 2006

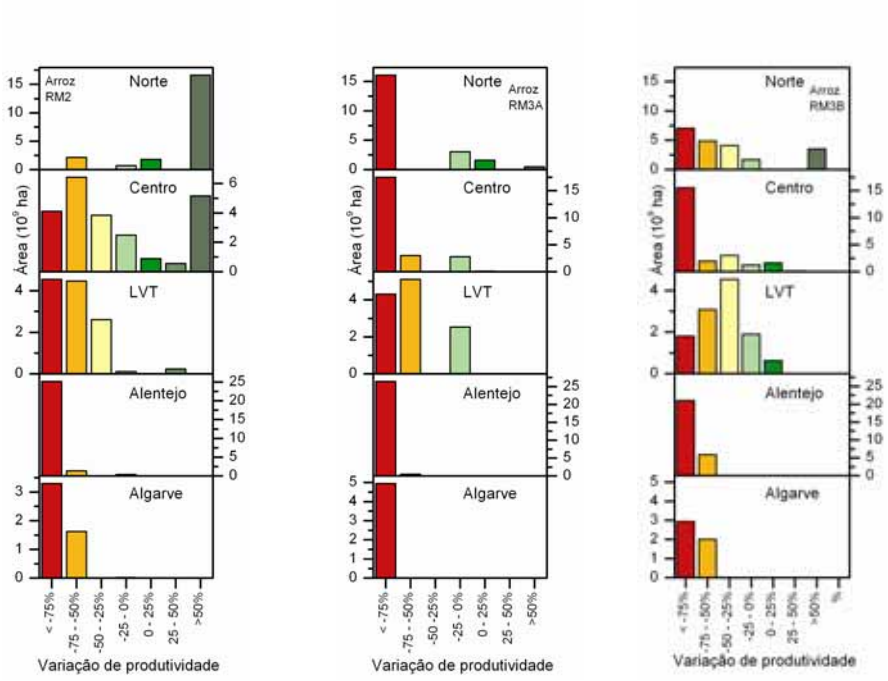

Figure 47. Differences in rice production obtained from several model simulations
Source: Santos et al., 2006

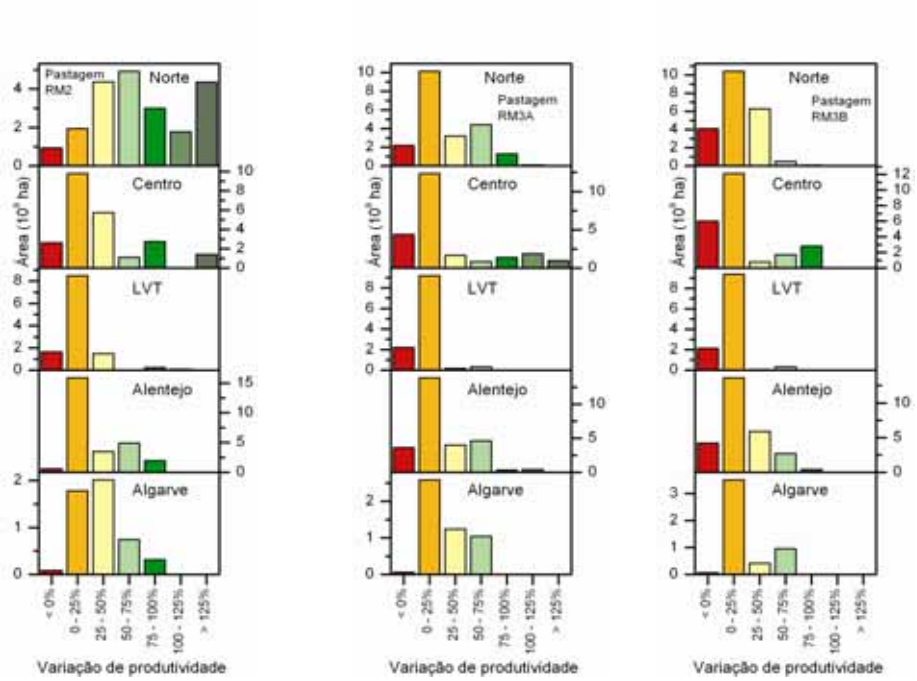

Figure 48. Differences in pasture production obtained from several model simulations
Source: Santos et al., 2006

5.2.6 Forests

Increased environmental stress is implicit in the scenarios developed by SIAM which forecast drastic changes in land areas propitious for current tree species, namely:

- a tendency for natural or induced displacement, from South to North and inland to coastal areas, of current species by those which are more tolerant to drought (Figure 49);
- a rise in temperature may allow species such as cork oak and pine to prosper at higher altitudes expanding their potential distribution. Presently, in more arid areas (for example in inland Southern regions), the environmental limits for forest survival may be exceeded;
- vegetation species better adapted to drought and high temperatures will be favoured by climate change, leading to an increase in biomass productivity in the Northern country (with greater incidence in the coastal compared to inland areas). However, species requiring moisture will have more moderate and localised production;
- biomass production will experience a moderate decrease in central inland areas. This may be more evident in the South, particularly in inland areas;
- a greater risk of fires, due to a possible increase in combustible forest biomass and favourable meteorological conditions. This tendency may be enhanced by predicted decreases in productivity.

The impact of climate change on forests may have negative effects on the economy, putting at risk the competitiveness of the industrial forest sector (cellulose, cork, plywood and furniture manufacturing) and the viability of more than 250 000 related work posts. Additionally, degradation and decrease of the productivity of forests puts at risk the sustainability of natural environmental services, such as the regulation of the hydrological cycle, protection against soil erosion, maintenance of biodiversity and its use for recreational purposes.

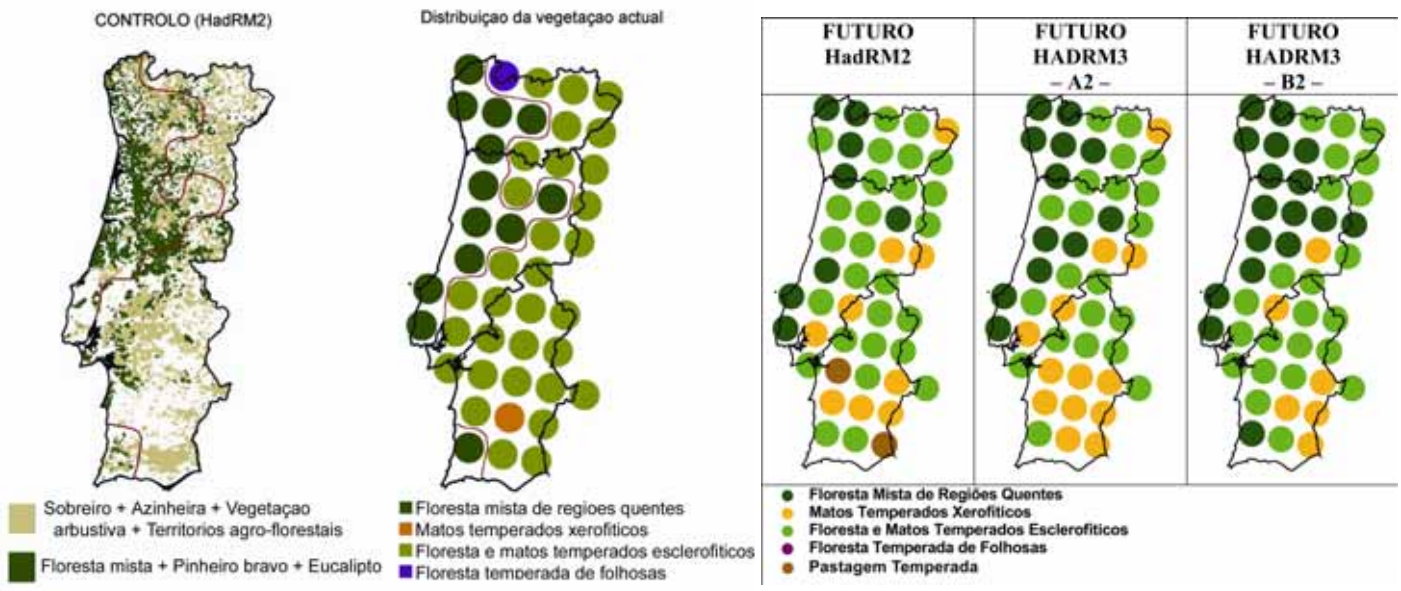

Figure 49. Current vegetation cover (CORINE land cover) (upper left) compared with the distribution of model biomes (upper right) and the distribution of the main biomes in continental Portugal according to reference scenario HadRM2 and future scenarios HadRM2 and HadRM3 (A2) (B2) (below)

Source: Santos et al., 2006

5.3 Extreme Weather Events

Extreme weather events (droughts, floods, heat waves and cold spells) occur in Portugal with socio-economic consequences dependent on the climate readiness of existing infrastructures to reduce these effects.

5.3.1 Heat Waves and Cold Spells

Temperature indices have confirmed an increase in mean temperature as well as a change in the frequency of very hot days and a reduction in the frequency of very cold days.

The incidence of cold spells[83] has decreased significantly in the last 20 years. Notwithstanding, a cold spell in February 1983 was the longest-lasting and most spatially far-reaching of any in the last 25 years.

In continental Portugal, heat waves[84] are more common and most noted for their impact in the summer months. The highest frequency of heat waves was recorded in the 1990s, with particularly long and widespread events in 1981, 1991, 2003 and, more recently, two heat waves between the end of May and June 2005 (Figure 50).

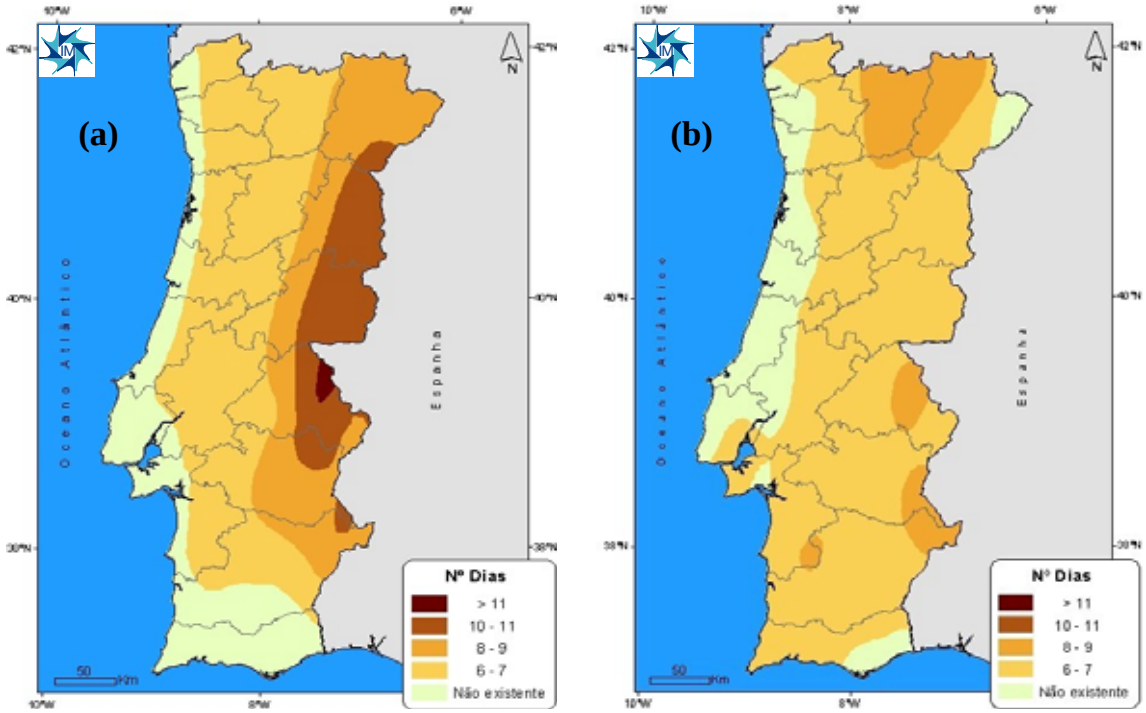

Figure 50. 2005 heat wave from 30th May to 11th June (left) and 15th to 23rd June (right)
Source: IM, 2005

[83] Cold weather experienced for at least six consecutive days in which the minimum daily temperature is 5 °C lower than the mean daily temperature.

[84] Hot weather experienced for at least six consecutive days with a maximum daily temperature 5 °C greater than the daily mean (using 1961-1990 as a reference).

On the 4th May, 2004, the Ministry for Health approved a contingency plan for heat waves (PCOC) in order to be able react to situations similar to those of 2003[85], which had effects on morbidity and mortality. The aim is to minimize the effects of high temperatures on health through a warning and adequate response system, to define guidelines for intervention and to strength the cross-institutional coordination. PCOC takes effect annually in the period from 15th May to 30th September.

Though PCOC is a sectoral plan, close collaboration amongst bodies with competences related to forecasting and warning systems was promoted, namely the Meteorology Institute (IM), the Fire and Civil Protection National Service (SNBPC) as well as the National Health Observatory of the Dr. Ricardo Jorge Institute of National Health (ONSA/INSA).

A prevention and warning system was implemented in accordance with PCOC in 2004, by means of information supplied by IM relating to weather forecasts, observed temperatures, bioclimatic comfort index, District-level weather warnings, as well as data supplied by ONSA/INSA using the Icarus Index for Lisbon and other regions, information from the Commissions for Regional Coordination and Development (CCDRs) and ozone levels provided by the Institute for the Environment (IA).

The implementation of a prediction and warning system is a fundamental tool for decision-making relating to the determination of daily alert levels to be broadcast so as to mitigate the undesirable consequences of heat waves and, in particular, increased mortality.

PCOC considers four warning levels:

- Level 1 – Blue warning – surveillance (period of 15th to 30th September);
- Level 2 – Yellow warning – effects on health foreseen;
- Level 3 – Orange warning - heat wave – severe consequences foreseen relating to health and mortality;
- Level 4 – Red warning - acute heat wave – very severe consequences foreseen relating to health and mortality.

SNBPC has also published information for the general public that offers advice on practical measures to reduce health risks during a heat wave (Figure 51).

The Icarus heat wave surveillance system was created in 1998 and implemented in 1999 using the heat wave of June 1981, which registered abnormally high numbers of human and animal deaths, as a reference. The system predicts the effects of heat waves on mortality through collaboration between the Directorate-General for Health (DGS), the Meteorology Institute (IM) and the participation of the Fire and Civil Protection National Service (SNBPC). The resulting Icarus Index is based on the number of predicted deaths:

- 0 – no effect (no warning)
- $0.31 < \text{Icarus} < 0$ – statistically non-significant effects on daily mortality
- $0.31 \leq \text{Icarus} < 0.93$ – possible effects on mortality
- $0.93 \leq \text{Icarus}$ at 1.55 – possible heat wave warning under analysis
- $1.55 \leq \text{Icarus}$ – heat wave warning: significant effects expected on health and mortality.

[85] High temperatures were recorded between May and September, and particularly between 29th July and 14th August 2003, during which time the temperature remained above 32 °C, exceeding 40 °C for two days.

Figure 51. Leaflet on preventive measures in the event of a heat wave.
Source: SNBPC, 2005

5.3.2 Droughts

Continental Portugal is susceptible to droughts, usually associated to the blocking effects of the North Atlantic subtropical high pressure fronts, which impede polar fronts from reaching the Iberian Peninsula.

Droughts are common in continental Portugal. However, its frequency and intensity have increased in the last decades of the 20th century. Drought was most severe in 1991/92, 1992/93, 1994/95, 1998/99, 1999/2000 and 2004/2005. The drought that began in late 2004 had impacted the whole country by the end of January of the following year. Precipitation values in January 2005 in Central and Southern regions were close to or lower than the minimum values previously observed, in some cases for as long as 100 years, as in the case of Lisbon and Evora which have not had a month of January without rain since 1901. MODIS satellite images show differences in vegetation cover in Portugal in the months of February 2005 and February 2004 (Figure 52).

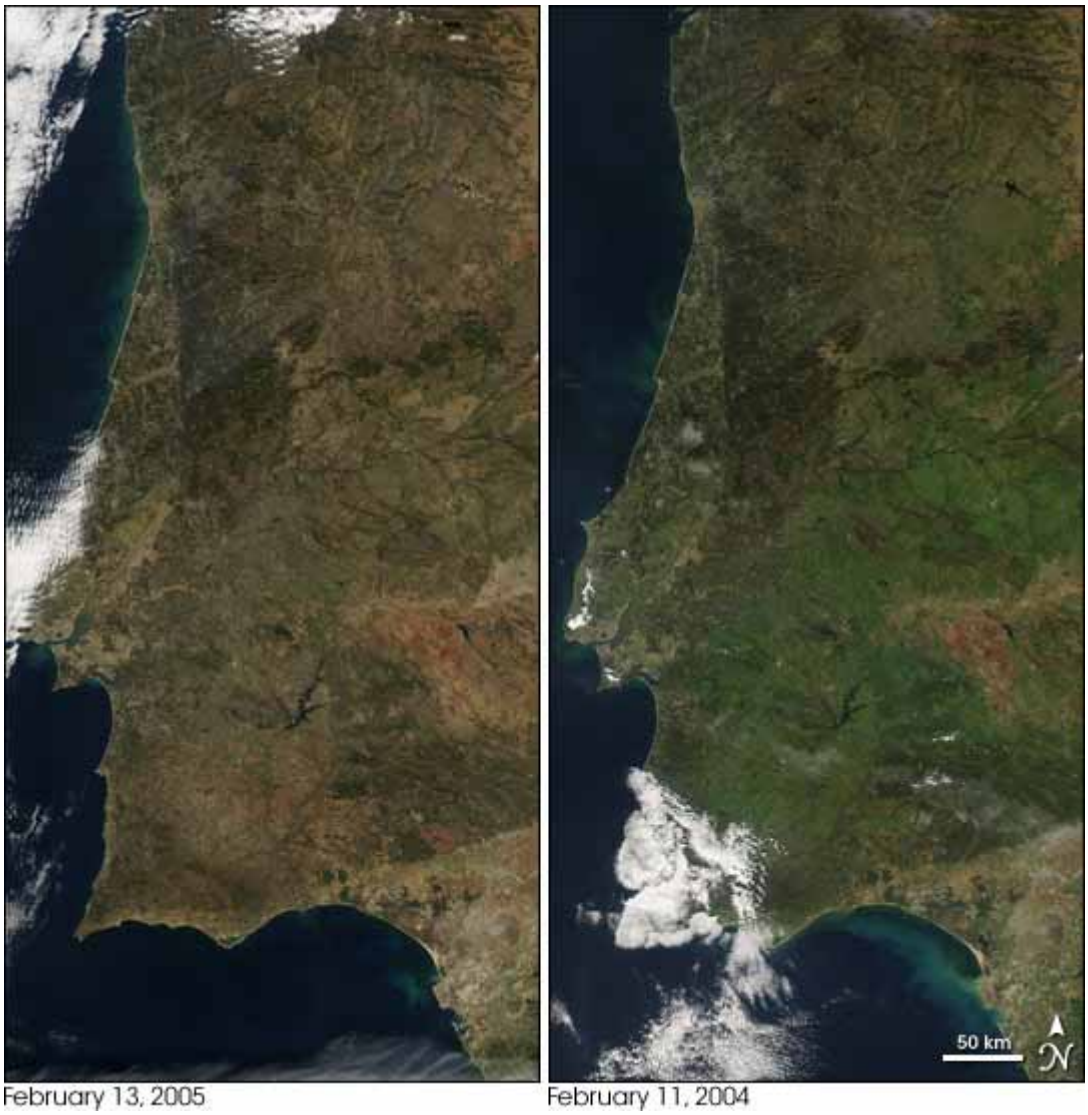

Figure 52. MODIS Satellite images show differences in vegetation cover in Portugal between February 2004 and February 2005

Source: http://earthobservatory.nasa.gov/NaturalHazards/

The drought that began in November 2004 was, by the end of the hydrological year (September 2005), the most severe in the last 60 years in terms of land area affected. The percentage of land area affected according to drought classes is presented in Figure 53, where a comparison can be made between 2005 values and those of the 30th

September of past drought years (1945, 1965, 1976, 1981, 1992, 1995 and 1999). With the exception of 1945 and 1995, meteorological drought had already ended by September (Figure 53). However, on the 15th December 2005, 85% of the territory was still under weak to moderate drought conditions.

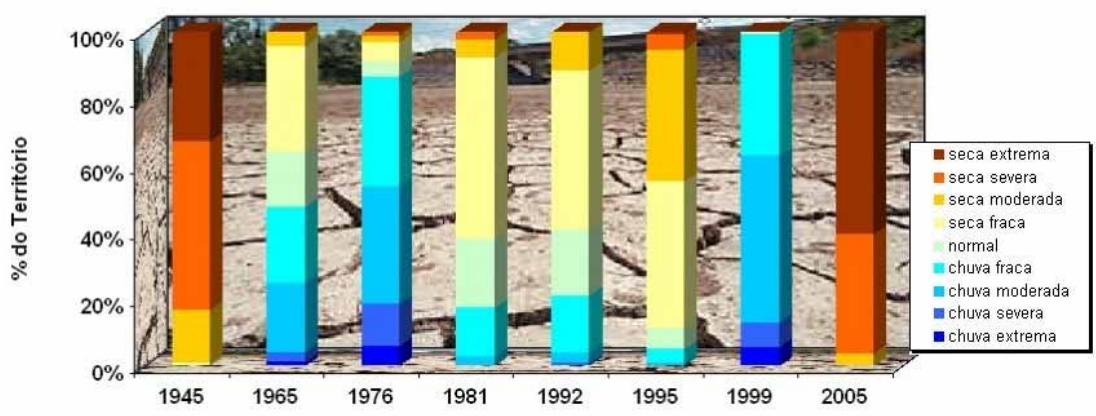

Figure 53. Percentage of land in mainland Portugal affected by drought, by classes

Source: IM, 2005

The number of consecutive months in which the Portugal was subject to drought of severe and extreme intensities is shown in Figure 54.

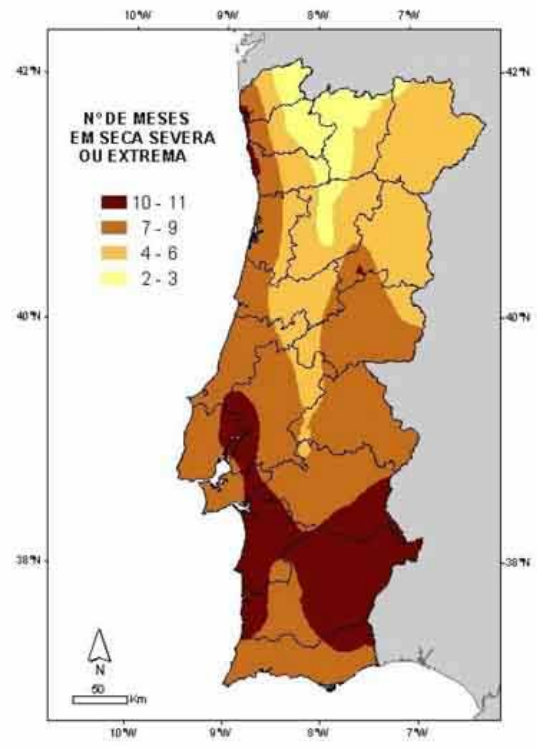

Figure 54. Severe and extreme drought in the hydrological year 2004-2005 by area and duration in consecutive months

Source: IM, 2005

In light of this situation, leaflets were published for public awareness on the need to save water (Figure 55).

Figure 55. Leaflet on preventative drought measures

Source: SNBPC, 2005

5.3.3 Forest Fires

In the last few years the Joint Research Centre (JRC) in Europe and the Meteorology Institute (IM) have investigated the relation between meteorology and fires in mainland Portugal based on the Canadian Forest Fire Weather Index (FWI) System (Figure 56). It was noted that Portugal and the other Southern European countries have, in varying degrees of spatial coverage and for the years considered, high weather-related fire risk (red). In the year 2005 the whole of mainland Portugal was subject to a high forest fire risk.

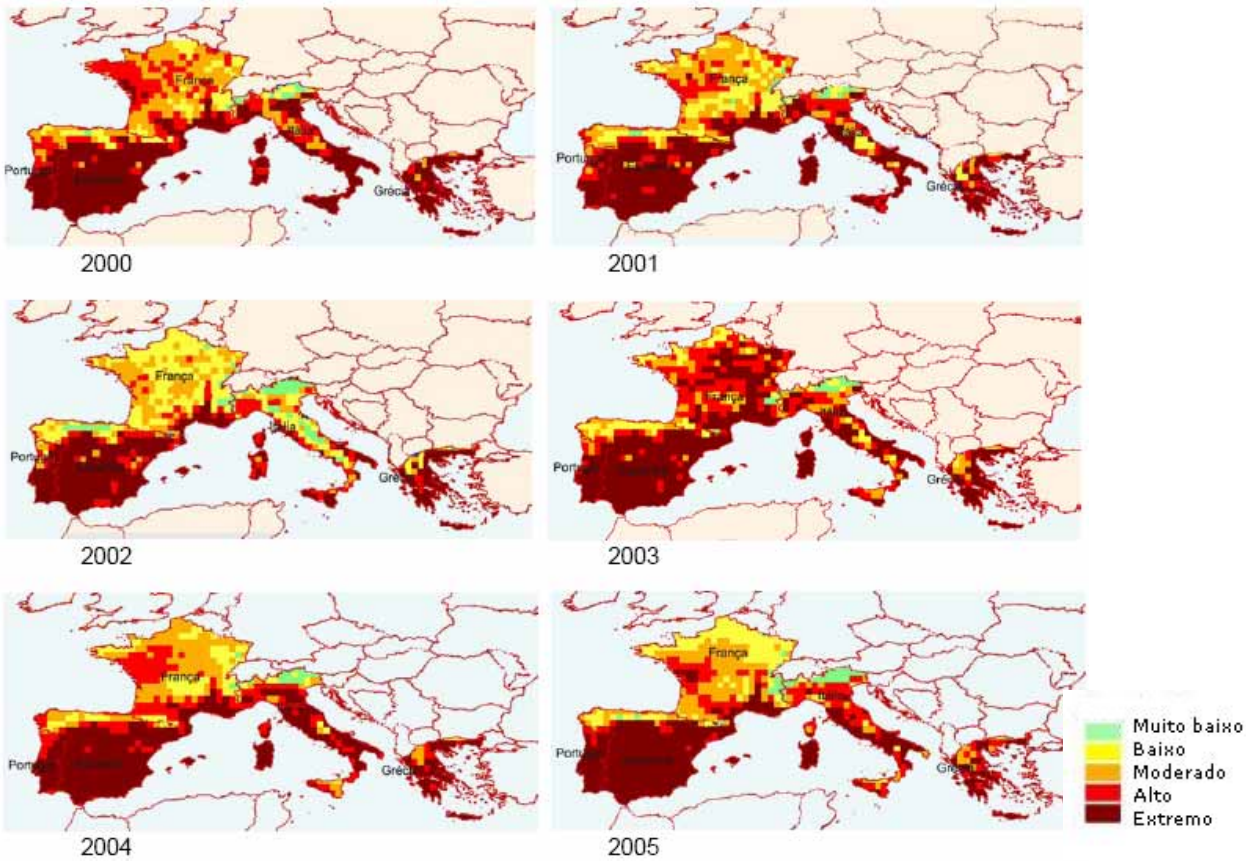

Figure 56. Weather-related fire risk
Source: *European Forest Fire Information System/ European Forest Fire Risk Forecasting System*

In recent years, forest fires of great dimension in mainland Portugal have forced society and the public administration to seriously consider appropriate measures.

Forest fires associated with the heat wave of 2003 resulted in an extremely large burnt area of land - 425 000 ha, corresponding to approximately 13% of the total forest area in the country (
Figure 57).

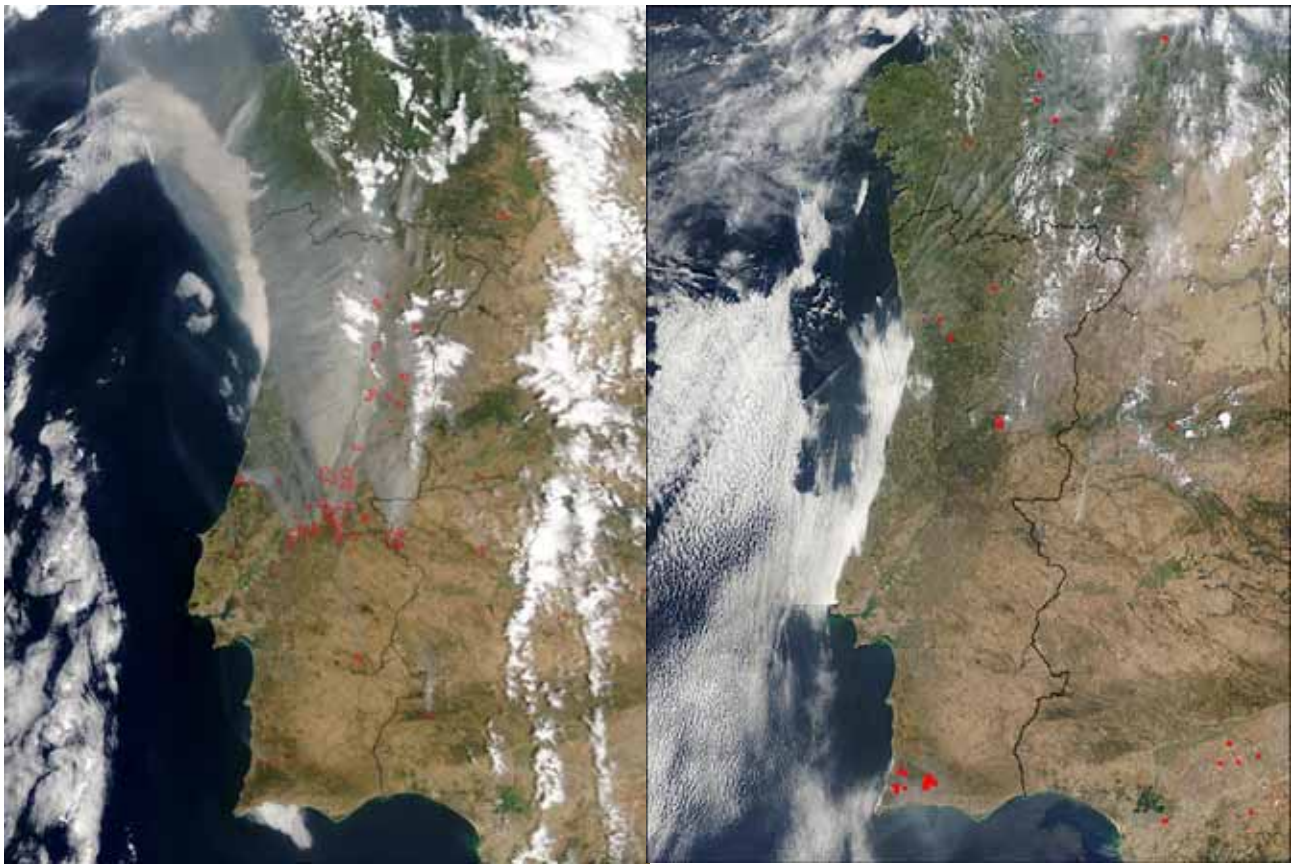

Figure 57. MODIS Satellite images showing forest fire incidents, 3rd and 13th August 2003.
Source: http://earthobservatory.nasa.gov/NaturalHazards/

A moderate reduction in the number of forest fire incidents was noted in 2004, with a significant reduction in burnt area (129 000 ha).

The frequency of fires in the National Network of Protected Areas (RNAP) and amount of burnt land has increased since 1992, though this trend has been moderately decreasing in the last years. The most serious incident occurred in 2003 when the summer in Portugal was exceptionally hot. The area of burnt land that year represented ¼ of the total area burnt over the last 13 years (1991 to 2003). In 2004 there were 573 forest fires in protected land areas resulting in 6467 ha being burnt.

The SNBPC published information materials to raise public awareness in relation to forest fires (Figure 58).

Figure 58. Leaflet on preventative measures relating to forest fires

Source: SNBPC, 2005

6 Financial Commitments, Technology Transfer and International Cooperation

6.1 Background to the National Policy on Development Cooperation

Development cooperation policy is determined and coordinated by the Portuguese Government, with the direct participation of the parliament and the necessary involvement of all relevant stakeholders, namely public administration bodies, municipal authorities, non-governmental organisations, business associations, universities, foundations and other social institutions. The strategic guidelines for Portuguese Cooperation are defined in a document named *A Strategic Vision for Portuguese Cooperation*, approved by the Council of Ministers Resolution 196/2005, on the 24th of November.

The policy is defined in the frame of the International Development Agenda and in accordance with successive commitments undertaken in various international fora. It also aims at implementing, in a coherent, effective and up-to-date manner, a strategic cooperation framework whereby the fight against poverty, inequity and social exclusion in developing countries are high priorities. Furthermore, such policy will also reflect an enhanced inter-connection between bilateral and multilateral cooperation, so as facilitate a better integration of Portuguese cooperation and Official Development Assistance (ODA) in global strategies.

In this backdrop, environmental issues, particularly those pertaining to climate change, are included in cooperation and ODA in an integrated way and mainstreamed in other intervention sectors like agriculture, fisheries, industry and tourism.

The period from 2001 to 2005 was characterized by the reform of the Portuguese Cooperation System and by resulting international commitments, namely those resulting from the United Nations Millennium Declaration, to which Portugal is bound. The most broad-reaching measure in this context was the creation of a single body, the Portuguese Development Support Institute (IPAD), resulting from the merger of two central administration bodies – the Portuguese Cooperation Institute (ICP) and the Portuguese Development Support Agency (APAD). This was the result of the Portuguese Government's decision to concentrate development cooperation in a single administrative structure with a dual role of key authority in policy development and lead agency for the funding of such policy, in a bid to improve the quality, cost-effectiveness and efficiency of services rendered. Such measure came as a response to the Development Assistance Committee (DAC/OECD) recommendation to clarifying the role of ICP and APAD in the Cooperation System, as well as the need to reinforce the role of the former as the coordinating entity.

Financial Planning and Budgeting mechanisms for Portuguese Cooperation were reinforced and improved in order to comply with the international commitments, such as the earmarking of 0.33% of Gross National Income[86] (GNI) to ODA by 2006. In this context, the creation of the Budgetary Programme for Portuguese Cooperation (P5), under the State Budget, was of special relevance, as it aims to concentrate and budget all cooperation activities developed by Portuguese Public Administration bodies. This programme constitutes an important instrument for compliance with guidelines, priorities and objectives in the context of policy for development cooperation, conferring more predictability, coherence and transparency to cooperation and ODA.

[86] Gross National Income (adopted as an indicator by DAC/OECD in 2000, with data revised until 1995).

Other commitments were agreed in the context of the European Union (EU) in important areas for sustainable development, namely the untying of aid[87], technical assistance related to trade, new forms of partnerships for the management and financing of global commons, and environmental conservation, policy coordination and harmonisation of procedures.

Table 27, below, shows ODA figures from 2001 to 2004.

Table 27. Total Official Development Assistance

	2001	2002	2003	2004
Bilateral ODA (MEuros)	204 695	197 443	161 494	702 446
Multilateral ODA(MEuros)	95 052	144 852	121 379	127 445
Total ODA (MEuros)	299 747	342 295	282 873	829 891
Total ODA (% GNI)	0.25%	0.27%	0.22%	0.63%

Source: IPADa, 2005

Portuguese ODA flows oscillated in the referred period, as a reflection of the constraints imposed by stringent public deficit control and budget consolidation efforts, as well as institutional reforms which beared impacts on the financial execution during the first implementation stage. ODA increased to a peak at 0.27% of GNI in 2002, a 14% increase comparing to the previous year, and then decreased to 0.22% in 2003. In 2004, ODA reached 0.63% of GNI as the result of the restructuring of Angola's debt.

Most of Portuguese ODA, corresponding to an average of 67% of assistance between 2001 and 2004, is channelled bilaterally. External assistance priorities are focused on Least Developed Countries[88] (LDC), particularly the five Portuguese-speaking African countries (PALOP) - Angola, Cape Verde, Guinea-Bissau, Mozambique and Sao Tome and Principe – and, more recently, East Timor which, in receiving on average 31% of bilateral ODA in the period 1999-2003, is the most significant beneficiary. In 2004, Angola became the biggest bilateral ODA beneficiary as a result of a debt restructuring operation amounting to 562 million Euros.

Portugal delivers its ODA mainly through technical cooperation and debt relief activities, and to a lesser degree but still noteworthy, direct government budget support of some partner countries and emergency and reconstruction aid. Tied aid has essentially occurred through the financing of small projects and the support to import programmes of consumer goods and equipment.

Technical cooperation (TC) is the most important item of bilateral assistance, facilitated by the historical and cultural ties and the institutional and legal frameworks common to Portugal and its partner countries. Technical cooperation is developed mainly through sectoral programmes or projects covering, among other activities, teacher training, placement of aid workers, scholarship awards (not only for studies in Portugal but also in schools within the beneficiary country) and technical assistance for capacity-building of third country institutions.

6.2 Financial Commitments and Multilateral Cooperation

Multilateral development cooperation policy is seen as an essential complement to bilateral cooperation, as well as a means of reinforcing Portugal's integration in the international system of development support. Portugal is in

[87] Tied aid refers to loans and grants whose concession to the beneficiary country is linked to the acquisition of goods and services from the donor country.

[88] The LDC are a group of 50 countries classified by the United nations as being the poorest in the world. Thirty-four of these countries are located in Africa, corresponding to approximately 600 million people.

compliance with the commitments that the international donor community has made at multilateral fora, namely in terms of resource allocation and improved effectiveness of ODA.

Portugal has been engaging ever more actively in the activities developed by the various international bodies and specialised agencies in the context of assistance to developing countries. It has been particularly active in its participation in a variety of international fora in Africa, Latin America and Asia, although its interventions still have a special focus on the Community of Portuguese Speaking Countries[89] (CPLP).

Portuguese multilateral contributions (Table 28) represented between 38% and 51% of total external assistance in the period 2001-2003, with a sharp drop to 20% in 2004. This reduction is not due to a decrease in multilateral contributions, which in fact increased as an individual item by 17% relative to the previous year, but rather to the marked increase in total assistance resulting from the expansion of the bilateral component.

The largest share of multilateral contributions is channelled through the EU, via instalments to the European Development Fund (EDF) which finances EU assistance to African, Caribbean and Pacific (ACP) countries, and contributions to the European Commission Budget for External Assistance which finances the assistance to developing countries not covered by the EDF. EU multilateral assistance has absorbed an average of three fourths (74.4%) of the total between 2001 and 2004. In the same period, the Regional Development Banks absorbed 17% of multilateral assistance, further broken down among the Agencies, Funds and United Nations Commissions (7%), the International Monetary Fund (IMF), the World Bank (WB), the World Trade Organisation (WTO) (6%) and other multilateral institutions (2%). From the other multilateral institutions, the CPLP received a share of 0.6% of multilateral ODA.

Portuguese multilateral cooperation with the ACP countries is defined in the context of the EU and its various mechanisms, with the Lome Convention playing an important role in EU's development cooperation policy and external relations. Its unique characteristics make it a true symbol of EU policy. The Portuguese Presidency of the EU (in 2000) presented a special opportunity for fostering partnerships between Europe and Africa, thus providing strong support to the Cairo Summit[90] and to the conclusion of EU/ACP negotiations, which in turn led to the signing of the Cotonou Agreement[91]. Portugal is still following the process initiated at the EU-Africa summit in Cairo and leading the debate, from an European perspective, on Conflict Prevention and Crisis Management theme, including land mines, in collaboration with the European Commission, France and Belgium.

Within the framework of the United Nations, Portugal has implemented co-financing mechanisms for projects in the PALOP countries and East Timor through trust funds, in the context of agreements with the United Nations Development Programme (UNDP) and United Nations Education, Science and Culture Organisation (UNESCO). Portugal also makes voluntary contributions to a wide number of United Nations (UN) agencies and funds, namely the World Food Programme (WFP), the HABITAT Programme (UN-HABITAT), the World Health Organisation (WHO), the United Nations High Commission for Refugees (UNHCR), the United Nations Population Fund (UNFPA), and the United Nations Children's Funds (UNICEF), among others.

[89] The Community of Portuguese Speaking Countries (CPLP) was created on the 17th July 1996 and is a privileged multilateral forum for deepening friendship and cooperation among its member-states: Angola, Brazil, Cape Verde, Guinea-Bissau, Mozambique, Portugal, Sao Tome and Principe and East Timor.

[90] The Europe-Africa Summit of Cairo, 3 and 4 April 2000, and the resulting follow-up mechanisms marked the beginning of a new era in the relationship between the EU and the African continent.

[91] Signed in Cotonou, Benin, in June 2000, the new partnership agreement, in force since April 2003, remains a unique model in North-South relations, based on cooperation for development, economic and trade relations and political dialogue. It reiterates the fight against poverty, the progressive integration of ACP countries in the world economy and sustainable development as EU-ACP cooperation objectives, adapting the relationship to a new world order (namely, in the trade front) and improving the effectiveness of assistance through a rationalisation of existing instruments.

Table 28. Portugal´s multilateral contributions 2001-2004 (millions of USD)[92]

Institution or Programme	Contribution			
	2001	2002	2003	2004
1. World Bank	0.30	6.88	10.83	12.41
2. International Finance Corporation	-	-	-	-
3. African Development Bank	5.26	0.17	16.71	9.30
4. Asian Development Bank	-	43.19	7.46	7.87
5. European Bank for Reconstruction and Development	1.06	1.12	1.33	1.47
6. Inter-American Development Bank	-	0.72	0.22	0.22
7. United Nations Development Programme – specific programmes	1.47	3.70	1.68	2.49
8. United Nations Environment Programme – specific programmes	-	0.06	0.02	0.04
9. UNFCCC – Supplementary Fund	0.04	0.07	0.07	0.05
10.Other	102.97	112.94	146.37	183.84
10.1 UNICEF - The United Nations Children's Fund	0.20	0.17	0.17	0.16
10.2 UNRWA – United Nations Relief and Works Agency	-	0.12	0.10	0.09
10.3 WFP – World Food Programme	0.04	0.22	0.22	0.21
10.4 UNHCR - Office of the UN High Commissioner for Refugees	0.22	0.17	0.19	0.31
10.5 UNFPA – United Nations Population Fund	0.04	0.07	0.02	0.29
10.6 Other UN	5.56	6.02	5.60	6.34
10.7 EDF – European Development Fund	12.39	12.37	19.51	31.79
10.8 EC – European Commission	56.62	60.92	68.88	79.15
10.9 EIB - European Investment Bank	-	-	-	1.51
10.10 Regional Banks	0.35	-	-	-
10.11 IFAD – International Fund for Agriculture Development	0.21	0.23	-	0.30
10.12 IMF – International Monetary Fund	-	-	-	-
10.13 Other Multilateral	1.61	1.43	3.05	4.44
10.14 EC for Part II of DAC	25.73	31.22	48.63	59.25
10.15 Other Multilateral Institutions for Part II of DAC	-	-	-	-
Total Multilateral[93]	**112.19**	**168.85**	**187.90**	**219.47**

Source: IPADa, 2005

In order to address global environmental problems, including those stemming from climate change, Portugal contributed to the Global Environment Facility a total of USD$ 6.08 million in the period from 2001 to 2004 (Table 29).

Table 29. Financial contributions to the Global Environment Fund (millions of USD)

	Contribution			
	2001	2002[94]	2003	2004
Global Environment Fund (GEF)	1.09	0	3.21	1.78

Source: IPADa, 2005

[92] Contributions to Part I organisations (ODA) and Part II (OA) of the DAC /OECD.

[93] The total amount includes financial contributions to the Global Environment Fund (GEF) (table 29).

[94] Due to a delay in accounting, GEF contributions for 2002 were considered in 2003.

6.3 Financial Commitments and Bilateral Cooperation

With regard to bilateral cooperation, political initiatives favour intervention in the Portuguese speaking countries – with which historical, linguistic and cultural ties exist – through public-private partnerships, the development of an appropriate financial support framework and the support to civil society organisations with relevant activities in this area. Portugal places specific interest in its participation in the context of the CPLP, aiming at reinforcing political and diplomatic relations with this group of countries, as well as contributing to their inclusion in international guidelines, so that they become active participants in the global economy and capable of overcoming poverty. The privileged relation of Portugal with these countries thus allows the development of capacities which enable the pursuit of sustainable development goals.

Table 30 shows the monetary values of Portuguese b
ilateral cooperation related to the implementation of the Convention, which amounts to a total of € 6 624 520 in the period from 2001 to 2005. This value has been on the increase, peaking in 2005 with a value of € 2 172 386.

Table 30. Bilateral and regional financial contributions related to the implementation of the Convention in the period 2001-2005 (Euros)

2001	2002	2003	2004	2005
958 250	1 042 991	662 158	1 788 735	2 172 386

Source: IPADa, 2005

6.4 Technology Transfer

Several projects were supported by Portuguese Official Development Assistance between 2001 and 2005 involving technology transfer of various kinds. With the objective of mainstreaming environmental and climate change considerations, Portugal has been focusing its support on technologies that allow for a more rational use of resources, particularly water and energy.

As a result, it has not been possible to present specific references and values in accordance with national communication guidelines for the time period under consideration.

6.5 Institutional Capacity-Building

Following the commitment by the EU, Canada, New Zealand, Norway and Switzerland at the Second Part of the Sixth Conference of the Parties in Bonn in 2001, agreed to contribute annually with 410 million dollars to support non-Annex I countries in climate change related projects (Bonn Political Declaration), as well as the decisions subsequently made within the EU, Portugal ensured in 2005 that its own share of annual international obligations were duly met (Table 31).

Table 31. Breakdown of Portugal's contributions in accordance with the Bonn Political Declaration (Euros)

Type of Contribution	2005	
	Description	Amount
Contributions for activities related to climate change in the context of GEF		
Additional bilateral and multilateral contributions	Multilateral contribution: participation at the LDC workshop (Bonn, May)	5000.00
	Multilateral contribution: participation in the Conference of the Parties (COP/CMP) and Subsidiary Bodies (SBs) (Cape Verde, Guinea-Bissau, Mozambique, Sao Tome and Principe)	17 584.22
	Bilateral Contribution: SICLIMAD-CV[95] Project	66 189.60
	Bilateral Contribution: SICLIMAD-STP[96] Project	35 151.00
Contributions for the Special Climate Change Fund (SCCF), the Adaptation Fund do Kyoto Protocol and the Least Developed Countries Fund (LDCF)	SCCF Contribution	1 070 000.00
Contributions resulting from the approval of CDM projects		-
Total (Euros)		**1 193 924.82**
Total (USD[97])		**1 753 995.99**

The funding available for compliance with the Bonn Declaration is new and additional relative to previous years, as it results from a new budget line of MAOTDR created specifically for this objective. Further to the integrated support already provided to other projects, the management of this specific funding line, under the responsibility of the Institute for the Environment, will support both mitigation and adaptation projects conceived for the implementation of the Convention and the Kyoto Protocol.

The referred funds will be managed in order to meet the objectives of the two regional networks established specifically to promote cooperation on the implementation of the Convention and Kyoto Protocol – the Portuguese Speaking Countries Climate Change Network (RELAC) and the Iberian-American Climate Change Network (RIOCC) – both promoted by Portugal between 2004 and 2005 in close collaboration with the involved countries. With similar goals and formats, these networks differ mainly by their geographical scope, being focused in Africa and Latin America respectively. Both these networks aim at promoting the exchange of knowledge and experiences between the regions, through specific mechanisms to be established.

RELAC includes Angola, Brazil, Cape Verde, Guinea-Bissau, Mozambique, Portugal, Sao Tome and Principe and East-Timor, and is a fundamental instrument for networking between CPLP countries. It will facilitate the exchange of perspectives and experiences, as well as the preparation of joint proposals on action against climate change.

RIOCC involves Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Equador, El Salvador, Spain, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Portugal, Dominican Republic, Uruguay and Venezuela.

[95] Climate and Sea Information System for Sustainable Development – Cape Verde.

[96] Climate and Sea Information System for Sustainable Development – Sao Tome and Principe.

[97] Dollar amount calculated using the exchange rate of the day of the transfer.

The general objectives common to both networks are:

- Keeping an effective and permanent dialogue amongst participant countries.
- Promoting the exchange of information on mitigation and adaptation policies, by identifying priorities and barriers to tackle climate change and its impacts.
- Supporting and promoting the implementation of the Convention and the Kyoto Protocol.
- Promoting capacity building initiatives and exchange of knowledge in the context of the Convention and the Kyoto Protocol.
- Identifying opportunities and promoting initiatives in the domain of education, training and public awareness on climate change.
- Exchanging views on possible ways forward in international negotiation fora.
- Supporting the integration of climate change strategies into development policies and ODA strategies, as complements to existing programmes.
- Facilitating initiatives aimed at taking advantage of opportunities in the context of the Clean Development Mechanism (CDM).

Projects in the context of these networks will be developed within the following areas of intervention:

- Capacity building
  - Exchange of information and/or experiences on methodological aspects, particularly with regard to the preparation of National Adaptation Programmes of Action (NAPA), GHG inventories, projects to be submitted to GEF and Clean Development Mechanism (CDM) projects.
  - Exchange of information and/or experiences on research and systematic observation on climate change.
- Adaptation
  - Collaboration and/or exchange of information and/or experience on vulnerability and impacts of climate change.
  - Collaboration and/or exchange of information and/or experience on adaptation strategies.
  - Development of NAPAs.
  - Use of funding mechanisms foreseen in the context of the Convention and GEF.
- Clean Development Mechanism
  - Identification of the main obstacles to the development and implementation of CDM projects.
  - Identification of possible opportunities for projects in RIOCC and/or RELAC countries.
- Capacity Building, Education and Public Awareness
  - Identification of other institutional capacity building needs not covered in the previous points and identification of potential activities that can contribute towards this end.
  - Promotion of the exchange of experiences and/or collaboration in education and public awareness-raising.

The following activities have taken place in the context of the RELAC objectives and work programme: meetings (both at technical and political level); approval of regional climate monitoring and research projects with Cape Verde and Sao Tome and Principe; and support to the PALOP delegations´ participation at the UN Conferences on Climate Change (COP11, COP/MOP1 and SB23) which took place in Montreal.

Several work meetings, the organisation of a workshop on National Communications in Mozambique and a CDM workshop in Angola and Brazil, are foreseen in 2006. Further to this, projects will be analysed and a website with relevant information for this network will be set-up.

7 Systematic Research and Observation

7.1 Scientific Research

7.1.1 General Policy on Scientific Research Funding

Scientific research in Portugal is generally undertaken in higher education institutions (universities, polytechnic universities and higher schools), state institutions (institutes, laboratories and scientific centres), private foundations and companies.

However, there has been a recent rise in the diversification of institutions involved in Research and Development (R&D) activities mostly as a result of a growing wish by the government to support the creation of new businesses and projects relating to technology and science, as well as to attract internationally renowned companies in these specific fields. There has also been a stronger commitment by private institutions, namely foundations and national and international companies, to support the development of a number of R&D projects in many areas. Despite these efforts, private-sector scientific knowledge creation is still far from playing a significant role in Portugal.

The Lisbon Strategy and European Council Conclusions adopted in Barcelona, which encompasses the Bologna Declaration, established strategic targets for 2010 associated to scientific, innovation and qualification of human resources indicators. In order be competitive, the Portuguese economy, in line with the Lisbon Strategy, requires a renewed and invigorated participation of both the public and private sectors, with investments in R&D representing 3% of GDP, of which 2% is to be derived from enterprise and 1% from the public sector. Currently, the public sector invests about 0.55% of GDP in R&D in Portugal.

To reach these targets, Portugal has reformed the structure of public expenditure and the incentives system to encourage growth and to boost scientific and technological development and innovation. This task involves doubling the scientific and technological research capacity of the country, which in turn reinforces the social and economic potential of Portugal.

The principal targets include:

- to encourage the private sector through incentives, tripling its entrepreneurial R&D efforts (which is currently no greater than 0.26% of the GDP);
- to triple the number of registered patents;
- to double public investment in R&D by up to 1% of the GDP;
- to promote the growth, by 50%, of human resources involved in R&D and the production of high quality scientific research of international calibre; to raise the number of Portuguese PhD doctorates to 1500 per year in Portugal and abroad;
- to encourage scientific employment in both public and private sectors. The State will support a progressive and competitive replenishment of staff, creating 1000 placements for R&D and reducing other less qualified placements in other administration sectors;
- to make experimental practice compulsory in scientific and technological subjects in primary and secondary schools; and
- to organise existing scientific and technological expertise with the aim of minimising and preventing public health hazards, increasing security as well as to strengthening regulatory and surveillance bodies in the country.

The Science and Technology Foundation (FCT), a subsidiary body of the Ministry of Science, Technology and Higher Education (MCTES), is directly responsible for coordinating and funding scientific research in Portugal.

In 2003 the total expenditure on R&D activities was 1020 million Euros, corresponding to 0.78% of the Portuguese GDP (Table 32).

Table 32. Total Expenditure in Research and Development (1999-2003)

	Year	1999	2001	2003
Total Expenditure in R&D	**Current Prices (MEuros)**	814.7	1038.4	1019.6
	Constant Prices[98] (MEuros)	842.6	995.9	911.5
	Annual average growth rate at constant prices	-	8.7	-4.3
	Expenditure R&D / GDP (%)	0.75	0.85	0.78

Sources: OCES/MCTES, 2005; OCDE, 2005 and INE, 2005

The Government, with co-finance by the European Union (EU) and private bodies, provide the funding for these R&D activities. According to the Science and Higher Education Observatory, R&D finance in 2003 was structured as follows: 60% by the state, 32% by companies, 5% by foreign investment and 3% by other national sources such as the higher education sector.

Public Budgetary Appropriations (DOP) between 2000 and 2004 are listed in Table 33. With 915 million Euros allocated to R&D, 2004 was the top year in the last two decades for R&D investment.

Table 33. Public Budgetary Appropriations (2000-2004)

	2000	2001	2002	2003	2004[99]
Current Prices (MEuros)	713	778	901	847	915
Constant Prices (MEuros)	603	629	693	636	672
Deflator[100]	1.183	1.237	1.299	1.333	1.363

Source: OCES, 2005

Research on climate change by means of scientific projects was financed exclusively by Government via FCT, with 2.7 million Euros invested between 2000 and 2004 (Table 34Table 34).

Table 34. Number or projects and funding granted in the area of climate change by the Foundation for Science and Technology (2001-2004)

	2000	2001	2002	2003	2004	Total
Number of projects	8	4	5	2	19	**38**
Funding granted (Euros)	538 701	420 096	435 395	110 000	1 307 500	**2 811 692**
Fraction of PBA in R&D (%)	0.08	0.05	0.05	0.01	0.14	**0.07**

Source: FCT, 2005

[98] Series of GDP implicit deflators (Base 2000 = 1), *Principaux Indicateurs de la Science e de la Technologie*. OCDE, 2005(1) – *Base de donnés.*

[99] Provisional values.

[100] The considered Deflators were the price indices implicit in the GDP, published by the OECD in April 2004 (Base 1995 = 1).

Of the Public Budgetary Appropriations for R&D in 2000-2004, 0.07% was allocated to climate change research. 2004, with an allocation of 0.14%, was the peak year for climate change research funding (Figure 59).

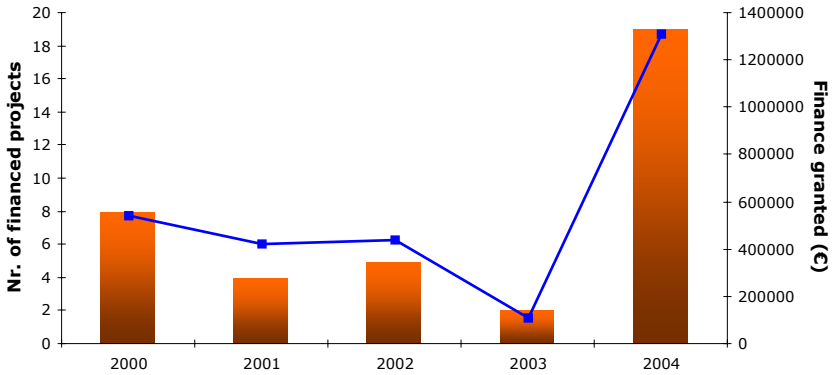

Figure 59. Investment by the Science and Technology Foundation on research projects relating to climate change (2000-2004)

Source: FCT, 2005

In 2004, a call for proposals by FCT for research projects included for the first time specific financing for climate change research, reflecting the greater attention that this theme is drawing within scientific community at both national and international levels. This shift demonstrates growing concern about energy and environmental issues (as well as related implications and impacts).

7.1.2 Climate Change Related Research Projects

Table 35 presents a list of research projects which have been sponsored by FCT between 2000 and 2004 and which, while covering various scientific fields, have particular relevance to climate change. For more detail, see Annex 4.

For more information on projects sponsored by FCT see: http://www.fct.mctes.pt/.

References are also made to two other projects financed by institutions other than FCT, one public and another private, considered to be projects relevant to this field.

Climate change in Portugal, scenarios, impacts and measures for adaptation (SIAM II).

The second phase of the SIAM project (Climate Change in Portugal: Scenarios, Impacts, and Adaptation Measures) involved research using updated climate models that featured two additional elements: public participation and a case study. The sessions in which there was public participation took place in Beja, Bragança, Covilha, Ílhavo, Olhao, Peniche and Oporto, where the impact of climate change and respective adaptation measures for local relevant sectors were discussed. This process involved the participation of 125 government, academic, environmental non-governmental organisations (NGOs) and industry representatives, as well as civil society representatives.

The case study of the hydrological basin of the Sado aimed to apply the general SIAM methodology at a more reduced scale, with a view to providing appropriately scaled information for public-sector decision-makers. (http://www.siam.fc.ul.pt/).

The Operational Environmental Programme of the Institute for the Environment (IA) financed the project (2004), proposed by the Faculty of Science and Technology (more information on Chapter 5).

Impact E – Impact of extreme events on health in Portugal: past, present and future.

A multidisciplinary team composed of researchers from several public national and international institutions in the fields of health, epidemiology, climatology, physics and environmental risk assessment was created to undertake this study. The aim is to provide an integrated study of the impact of meteorological and extreme climate events (cold spells, heat waves and drought) and related elements such as air pollution and forest fires on public health in Portugal. Past correlations and projections of future risks based on climate scenarios until the end of the century will be used.

The Calouste Gulbenkian Foundation financed this project, proposed by the Faculty of Science of the University of Lisbon.

7.1.3 National Participation in International Research Networks

Portugal has been represented in meetings of the International Panel on Climate Change – IPCC - since 2001 by a nominated focal point at the Meteorology Institute (IM).

The Focal Point's role includes the following functions:

- participation in the IPCC 18th plenary session in London, UK, 24th – 29th September, 2001;
- participation in the IPCC 19th plenary session in Geneva, Switzerland, 17th – 20th April, 2002;
- chairing informal coordination meetings on behalf of the President of the Regional Association VI (RA VI) for Europe and the Middle East;
- directing the appointment process of candidates from the RA VI (IPCC/World Meteorological Organisation) to placements in various groups of the IPCC Bureau during the IPCC 19th plenary session;
- chairing negotiation meetings in the scope of the RA VI at the 19th plenary session;
- organisation of three meetings with candidates to the IPCC Presidency, to get to know candidates´ profiles and their respective proposals, through open discussion.

Portugal has also participated, since 2005, in the European project CIRCLE (Climate Impact Research Coordination for a Larger Europe). It is represented by the FCT (MCTES) with € 3 000 000 in EU funding.

CIRCLE's prime objective is to contribute to scientific knowledge in the field of climate change by encouraging collaboration, complementarities and efficiency of the national programmes on climate change throughout the EU. This process will provide a strong support for the implementation of a European Research Area Network (ERA-NET) in the field of climate change.

The CIRCLE project was initiated in the summer of 2004 and its activities were extended in the form of a contract ERA-NET for the period of 2005-2009. To date, CIRCLE has compiled information on climate change impacts and adaptation measures from national research programmes.

In total, 27 institutions from 16 European countries have joined CIRCLE. These institutions (ministries of science and technology or research foundations) finance or manage national research programmes on climate change and, through CIRCLE, their methodologies, strategies and data may be shared in order to optimise, complement and develop national programmes within an EU framework. Portugal contributes with information on impacts and adaptation measures from the SIAM Group, which is the Focal Point for this project.

Table 35. Research projects in the field of climate change funded by the Science and Technology Foundation (2000-2004)

Reference	Title	Proposing Institution	Scientific Area	Funding Granted (Euros)
POCTI/CTA/32649/2000	Black carbon levels in the atmosphere over the North Atlantic ocean	Institute of Marine Research	Earth and Atmospheric Sciences	59 855.75
POCTI/CTA/33582/2000	Reduction of uncertainties of estimates of atmospheric emissions from fires in Southern Africa	Technical University of Lisbon - Higher Institute of Agronomy	Earth and Atmospheric Sciences	74 819.68
POCTI/CTA/34346/2000	Climate change in Portugal: impact on the occurrence of forest wildfires and on the air quality	University of Aveiro	Earth and Atmospheric Sciences	79 807.66
POCTI/CTA/35598/2000	Portuguese wood industries: greenhouse gas fluxes and accounting methods for the evaluation of the global warming effect	University of Aveiro	Earth and Atmospheric Sciences	49 879.79
POCTI/CTA/35626/2000	Carbon balance of eucalypt plantations in Portugal – the Kyoto forest problem	Technical University of Lisbon – Higher Technical Institute	Earth and Atmospheric Sciences	99 759.58
POCTI/CTA/36258/2000	Aquifers as archives of palaeoclimate and indicators of future climatic scenarios - Sado-sines system and bairrada carsic aquifer	University of Lisbon – Foundation of the Science Faculty	Earth and Atmospheric Sciences	49 879.79
POCTI/MGS/33592/2000	OIKOMATRIX - Evaluation of the socio-economical impact of legal tools to control the emission of green house gases	University of Aveiro	Modelling and Management of Environmental Systems	49 879.79
POCTI/MGS/34883/2000	Built environment, urban climate and rational use of energy	National Institute of Engineering, Technology and Innovation	Modelling and Management of Environmental Systems	74 819.68
POCTI/CTA/11048/2001	Climate Change in Portugal: Scenarios, Impacts and Adaptation Measures (SIAM)	University of Lisbon – Foundation of the Science Faculty	Earth and Atmospheric Sciences	88 617.00
POCTI/CTA/38326/2001	Study of forcing mechanisms of low frequency atmospheric variability in the euro-Atlantic region	University of Aveiro	Earth and Atmospheric Sciences	47 000.00
POCTI/CTA/39607/2001	CLIVAR - Climate variability and change: patterns and impacts at the regional scale	Institute of Science of the Earth and Space	Earth and Atmospheric Sciences	85 000.00
POCTI/MGS/37970/2001	GENETICLAND: discovering future landscapes under climate change scenarios using genetic algorithms	Institute of Marine Research	Modelling and Management of Environmental Systems	99 475.00
POCTI/MGS/41874/2001	OIKOMATRIX II – evaluation of the socio-economical impact at regional level of legal tools to control the emission of greenhouse gases	University of Aveiro	Modelling and Management of Environmental Systems	100 000.00

Reference	Title	Proposing Institution	Scientific Area	Funding Granted (Euros)
POCTI/CTA/46573/2002	VAST - variability of Atlantic storms and their impact on land climate	University of Lisbon – Foundation of the Science Faculty	Earth and Atmospheric Sciences	55 000.00
POCTI/CTA/47803/2002	SIGN - signatures of environmental change in the observations of the geophysical institutes	Institute for Earth and Space Sciences	Earth and Atmospheric Sciences	80 000.00
POCTI/MGS/49210/2002	Assessment of climatic change impact on water resources and CO_2 fixation in fast growing forest stands in Portugal	University of Aveiro	Modelling and Management of Environmental Systems	150 392.00
POCTI/AGG/47275/2002	Adaptation of pine shoot beetle to host pine physiology under the influence of climate change	Technical University of Lisbon – Higher Institute of Agronomy	Agricultural Sciences	80 000.00
POCTI/AGG/47938/2002	Effects of elevated CO_2 and interacting environmental variables on grapevines grown under Mediterranean field conditions	University of Trás-os-Montes and Alto Douro	Agricultural Sciences	70 000.00
PDCTE/CTA/49826/2003	Cloud properties retrievals from ENVISAT in the presence of aerosol events over Portugal	University of Evora	Programme for the Promotion of Space Science and Technology	50 000.00
PDCTE/CTA/49985/2003	CARBERIAN - Terrestrial vegetation carbon trends in the Iberian peninsula exploratory analysis from Northern Atlantic oscillation related behaviour	Institute of Marine Research	Programme for the Promotion of Space Science and Technology	60 000.00
POCI/CLI/56269/2004	Climate Change and Tourism in Portugal: Potential Impacts and Adaptation Measures (CLITOP)	University of Lisbon – Foundation of the Science Faculty	Climate Change	75 000.00
POCI/CLI/56371/2004	BioAridRisk – Space-Time Evaluation of the Risks of Climate Changes based on an Aridity Index	Technical University of Lisbon – Higher Technical Institute	Climate Change	50 000.00
POCI/CLI/57597/2004	Climatic /environmental factors affecting the population dynamics of *Lymnaea truncatula* and transmission of *Fasciola hepatica* in Portugal.	Institute of Tropical Medicine and Hygiene	Climate Change	95 000.00
POCI/CLI/58348/2004	Present and Future Portuguese Coastal Climate and its impact on the biological communities (PORTCAST)	University of Lisbon – Foundation of the Science Faculty	Climate Change	90 000.00
POCI/CLI/58680/2004	Climate change inferences from tree rings in the Mediterranean area: a database for Portugal	Institute of Marine Research	Climate Change	50 000.00
POCI/CLI/58865/2004	CIDmeg – CIDmeg - Construction of a Desertification Susceptibility Index for the Left Margin of Guadiana	Technical University of Lisbon – Higher Technical Institute	Climate Change	85 000.00

Reference	Title	Proposing Institution	Scientific Area	Funding Granted (Euros)
POCI/CLI/60006/2004	Linking Water and Carbon Cycles in Eucalypt Plantations	National Institute for Agriculture and Fisheries Research	Climate Change	95 000.00
POCI/CLI/60110/2004	ALQUEVA XXII - Shooting at a moving target. Scenarios of agricultural land use of the alqueva irrigation project in a changing environment.Climate change, crop options and water needs.	Technical University of Lisbon – Higher Agronomy Institute	Climate Change	70 000.00
POCI/CLI/60192/2004	Impact of climatic and anthropic variations on the Northern continental shelf, Gulf of Cadiz)	University of Algarve	Climate Change	95 000.00
POCI/CLI/60413/2004	Vulnerability of cork oak woodlands to climate change: a modelling approach	Technical University of Lisbon – Higher Agronomy Institute	Climate Change	95 000.00
POCI/CLI/60421/2004	Urban flood risk and pollutant relocation as a result of global change	Higher School of Agriculture of Coimbra	Climate Change	90 000.00
POCI/CLI/60784/2004	Use of traditional knowledge to attain water sustainable management under different climate change scenarios - TRADWATER	University of Aveiro	Climate Change	90 000.00
POCI/CLI/61605/2004	Latitudinal variation on the biology of estuarine key-species as a tool to predict climate change effects	Maritime and Environmental Research Centre	Climate Change	50 000.00
POCI/AGR/57279/2004	Simulation of the effect of different management and climate change strategies in the production of wood / cork and in the carbon sequestration for the main species of the Portuguese forest	Technical University of Lisbon – Higher Agronomy Institute	Agricultural Sciences	85 500.00
POCI/AGR/59152/2004	Mediterranean woody species of montados: surviving the drought	National Institute for Agriculture and Fisheries Research	Agricultural Sciences	85 500.00
POCI/COM/56973/2004	The politics of climate change: discourses and representations	University of Minho	Communication Sciences	30 000.00
POCI/MAR/56296/2004	Studying the impact of the climate change in the Portuguese coastal waters - the Aveiro costal ecosystem -SIMCLAVE	University of Aveiro	Science and technologies of the Sea	76 500.00

Source: FCT, 2005

7.2 Systematic Observation

7.2.1 General Policy on Systematic Observation

Activities relating to systematic observation follow policies determined by international organisations in which Portugal participates, including the World Meteorological Organisation (WMO) and the EU. Portugal is mainly involved through the World Climate Programme (WCP), its research component (WCRP) and the International Geosphere-Biosphere Programme (IGBP).

The Institute for Meteorology (IM), governing body responsible for meteorology and climate commitments, has provided continuity of scientific and technical activities relating to climate change observations, which have been carried out in Portugal since 1856. These multi-parameter climate series support research pertaining to trends, variability and analysis of extreme climate events.

At the international level, Portugal contributes, through the IM, to the maintenance and improvement of the global observation system by taking part in Earth observation programmes, particularly satellite programmes of the Organisation for the Exploitation of Meteorological Satellite programmes (EUMETSAT) and the Global Climate Observing Systems (GCOS). Data obtained in the scope of GCOS are archived by and made available from the following international centres:

- World Data Centre for Greenhouse Gases (WDCGG) in Japan;
- World Radiation Data Centre (WRDC) in Russia;
- World Ozone and Ultraviolet Radiation Data Centre (WOUDC) in Canada;
- World Data Centre for Aerosols (WDCA) / Aerosols Optical Depth (AOD) in Italy;
- World Data Centre for Precipitation Chemistry (WDCPC) in the United States of America ;
- World Data Centre for Meteorology (WDCM) in the United States of America;
- Finnish Meteorological Institute (FMI) in Finland;
- and The National Climatic Data Centre (NCDC) in the United States of America.

Data collected and sent to international centres by the IM network include global, diffuse and direct solar radiation, total ozone, surface ozone, ultra-violet radiation, precipitation chemistry, and chemistry of the atmosphere and of particles. Meteorological surface and upper air data is sent daily in real time. In addition to sharing of these databases and results analysis, the IM participates in prediction model work groups, and partakes in consortia for conception and distribution of products of scientific and economic applications.

For more information regarding Portugal's participation in projects for systematic observation please visit http://www.meteo.pt/.

Continued systematic observation through station networks is fundamental for both climate analysis and monitoring, as well as for long term planning of strategic resources, and thus involve regular investments in equipment, education and conservation, to ensure reliability of data.

7.2.2 Atmospheric Climate and Composition Observing System

There are currently 115 meteorological stations and 700 udometric stations. Comprising some 9 stations per 1000 km^2, climatological network average density is comparable with the European average.

Portugal's participation, through the IM, in the Global Atmospheric Observation System has remained constant in recent years (Table 36).

Table 36. Participation in the Global Atmospheric Observation System

	GSN[101]	GUAN[102]	GAW[103]	CLIMAT[104]
Number of stations under Portugal's responsibility	4	1	8	15
Number of stations currently operational	4	1	7	15
Number of stations operating in accordance with the GCOS standards	4	1	7	15
Number of stations operating in 2005	4	1	7	15
Number of stations providing data to international data centres	4	1	7	15

Source: IM, 2005

The national meteorological network includes 3 stations measuring UV-B radiation, 4 stations measuring total ozone concentrations and 3 aerologic stations, operating within the framework of the Global Atmosphere Watch (GAW) coordinated by the WMO, the European Monitoring and Evaluation Programme (EMEP) of the United Nations Economic Commission for Europe (UNECE) and the Comprehensive Atmospheric Monitoring Programme (CAMP) and the Convention for the Protection of the Marine Environment in the North-East Atlantic – Oslo and Paris Commission (OSPAR). The IM is responsible for ensuring the continuity of observational programmes and the expansion of the Portuguese observation network. Currently, the network on Global Atmospheric Composition of the IM includes 7 stations.

The IM also collaborates with the Cooperative Programme for Monitoring and Evaluation of the Long Range Transmission of Air Pollutants in Europe (EMEP) in the areas of atmospheric deposition and ozone observation.

These observation programmes include the monitoring of: total ozone quantities using spectrophotometers; UV intensity using spectrophotometers and wide band detectors; surface ozone concentration using photometric analysers; concentrations of suspended particulate matter using high volume samplers; concentrations of sulphur dioxide (aerosols and gas) using sequential samplers; concentrations of carbon dioxide and methane; pH, conductivity, concentration of ions and metals in rain water samples (wet deposition) and in dry depositions using automatic collectors.

7.2.3 Ocean Climate Observing System

IM participates in the Ocean Climate Observation Systems featured in Table 37.

[101] GCOS Surface Network.

[102] GCOS Upper Air Network.

[103] Global Atmosphere Watch.

[104] CLIMAT – International exchange of monthly mean data is realised through official notices in CLIMAT code form.

Table 37. Participation in the Global Oceanographic Observation System

	VOS[105]	SOOP[106]	TIDE GAUGES	SFC[107] DRIFTERS	SUB-SFC[108] FLOATS	MOORED BUOYS	ASAP[109]
Number of platforms under Portuguese responsibility	0	0	12	0	0	0	0
Number of platforms providing data to international centres	0	0	4	0	0	0	0
Number of platforms operating in 2005	0	0	17	0	0	0	0

Source: IM, 2005

7.2.4 Global Terrestrial Observing Systems

Portugal does not participate in projects related to Global Terrestrial Observing Systems, namely GTN-P, GTN-G and FLUXNET. Some projects could be classified under this category but are described in the following section.

7.2.5 Programmes Based on Space Observations

Remote Sensing

Portugal is a founding member of the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and participates in several of its programmes.

Of particular importance is the project Satellite Application Facility on Land Surface Analysis (LSA SAF), which is coordinated at a national level by the IM. This project has both research and operational targets, the former dedicated to the development of algorithms that determine land parameters via satellite data, and the latter to the generation, archiving and dissemination of surface parameters. Both EUMETSAT and IM co-finance the long-term monitoring of the ground segment in this project (Resolution EUM/C/92/Res.V, contract EUM/LAD/CA/04/0489) divided into three stages: a first developmental phase lasting 5 years which was concluded in February 2005, a second, initial operational phase (current stage of the project) to be completed in February 2007, and a third operational stage predicted to take at least eighteen years to complete.

The scientific framework of this project is based on physical parameters and an integrated approach in order to maximise temporal, spatial and spectral resolutions provided by satellite sensors, Meteosat (MSG) and EUMETSAT Polar System (EPS). The scientific activities under development by the LSA SAF including observation and characterisation of surface biosphere processes have several applications including: weather and climate modelling; environmental management and land use; and management of natural disasters.

[105] Volunteer Observing Ship

[106] Ship of Opportunity Programme

[107] Surface Drifters

[108] Sub-Surface Drifters

[109] Automated Shipboard Aerological Programme

The strategy behind the structure and activities of LSA SAF was to explore synergies between the various institutions involved in the development of physical parameters in order to optimise the efficiency of the institutions for processing and an appropriate balance between innovative and robust parameters to support long periods of operation. This approach was taken with the aim of benefiting the majority of users. The following parameters were selected: albedo, aerosols, solar radiation flux, surface temperature, emissivity, thermal radiation flux, vegetation indices, soil moisture, evapotranspiration and snow cover. Operational activities include the processing, archiving and distribution of these parameters, in real or time or otherwise.

Geoland is an Integrated Project for research, technological development and demonstration, within the context of the European Commission's Sixth Framework Programme (FP-6 Priority AERO-2.2 - Aeronautics and Space). The project aims to provide and establish geo-information products and services to support the European Global Monitoring for Environment and Security (GMES) programme, generated by the European Commission in collaboration with the European Space Agency. The objective of the programme is to provide the EU, by 2008, with expertise for global monitoring to support European objectives for environment and security.

The project will integrate Earth Observation available resources and existing models with pre-operational end-user applications, namely those that enable a more efficient follow-up, monitoring and management of land and vegetation cover as well as those involved in the development of products and services to be implemented in European policies and Directives as well as by international Conventions. The project is a consortium of 56 partners, including the IM, comprising enterprise, authorities, end-user institutions and organisations, service providers and researchers.

The Geoland products and services aim at monitoring land and vegetation cover by addressing the GMES priorities, namely, "Land Cover Change in Europe", "Environmental Stress in Europe", and "Global Vegetation Monitoring".

In Portugal, the CORINE Land Cover 2000 (CLC2000) project was developed in the scope of IMAGE and CORINE Land Cover 2000 (I&CLC2000), an initiative developed by the European Commission to map land use in Europe in the year 2000.

The CLC2000 project in Portugal was jointly financed by the IA and the European Commission, managed by the Higher Institute of Statistics and Information Management (ISEGI) in collaboration with the Portuguese Geographical Institute (IGP).

The I&CLC2000 project consists of two components:

- IMAGE2000 – coordinated by the Joint Research Centre (JRC), encompasses all activities regarding acquisition of satellite images, ortho-rectification and production of image composites at national and European levels; and
- CLC2000 – coordinated by the European Environment Agency (EEA), covers all activities related to the generation of CLC2000 cartography products including its geometric and thematic update, designated as Revised CLC90 (CLC90-R).

CORINE Land Cover cartography products contain updated and comparable information on land use and land cover in mainland Portugal.

For a report on changes to the landscape using CLC90 and CLC2000 land cover databases please see: http://elara.iambiente.pt

Meteorological Radars

The IM uses and develops a national meteorological radar network and aims to upgrade it through the acquisition, installation, application and integration of a new system - the Northern mainland meteorological radar. Through this network it is possible to monitor land cover for the whole of mainland Portugal. The exploitation of the operational potential of this sensor will also complement other meteorological radars to determine the global land cover of the Iberian Peninsula.

Some of these developments are within the framework of Action COST (European Co-operation in the field of Scientific and Technical Research), in particular COST731, Propagation of Uncertainty in Advanced Meteo-Hydrological Forecast Systems, where the aim is to encourage the exchange of scientific and technological information and address issues associated with quality and uncertainty of meteorological observations from remote sensing and other conventional instrumentation, along with their impacts and benefits on hydro-meteorological outputs from advanced forecasting systems.

7.2.6 Assistance to Developing Countries

Ongoing scientific and technical collaboration is maintained with developing countries, namely with institutions of the Portuguese Speaking Countries. The activities include, among others, the continued participation of the IM in several operational and R&D projects, in particular with Sao Tome and Principe and Cape Verde, in the fields of Systematic Observation and models for weather, climate and ocean turbulence.

Within the framework of the Portuguese Official Development Assistance and in the context of the Bonn Political Declaration, several cooperation protocols were celebrated with Cape Verde and Sao Tome and Principe in 2005, and a similar one with Guinea-Bissau is foreseen in 2006, for implementation of the Climate and Sea Information System for Sustainable Development (SICLIMAD) project in these countries.

The SICLIMAD project is characterised by the use of meso-scale numerical models, also known as regional scale models. Through climate modelling, regional scenarios for possible climate change have been established. The project thus provides a fundamental instrument to support political and economic decision-makers in determining policies for mitigating and adapting to the adverse effects of climate change. This yields invaluable positive impacts for society as a whole.

This aspect is of particular relevance since Cape Verde and Sao Tome e Principe are archipelagos, both with extensive Exclusive Economic Zones. Operations connected to the many socio-economic activities directly or indirectly related to the sea are strongly dependent upon the hydrodynamic conditions of the ocean.

The global objectives of SICLIMAD aim at:

- creating a climate information system that allows for comprehensive action against anthropogenic or natural climate change, in Cape Verde and Sao Tome and Principe, by establishing scenarios of climate system trends and evaluating climate change impacts. Furthermore, they also seek to identify adaptation measures that will make up a system to support political and economic decision-makers in actions against climate change, while also contributing to poverty eradication and, consequently, regional sustainable development;
- contributing to a better understanding of the climatic system, its interaction mechanisms and the way these influence local climates, and their expected impacts upon the various ecosystems, quality of life, economy and natural resources; and

- implementing a regional-scale Weather and Sea Forecasting System in Cape Verde, based on the Regional Atmospheric Modelling System *(*RAMS), developed by the University of Colorado by Cotton et al. (1989) and on the Simulating Waves Nearshore (SWAN) sea model, adjusted for the oceanic area around Cape Verde and Sao Tome and Principe.

Also noteworthy is the scientific and technical cooperation with the Meteorological and Geophysical Services of the Special Administrative Region of Macau and the Meteorological Administration of the Popular Republic of China. Under the protocol established between the IM, the Meteorological Service of Macau and the Meteorological Administration of China, scientific and technical cooperation continues in the domain of Radar Meteorology and its applications, namely the development of precipitation measuring techniques using radar technology.

8 Education, Training and Awareness Raising

8.1 General policy guidelines on Education, Training and Public Awareness

Climate change and other environmental issues are cross sectoral themes which are present in different forms in school curricula. In the current reorganisation of the curriculum for primary education and the revision of that for secondary education, this theme is specifically covered in some subjects.

The education system's Framework Law 46/86, of October 14th altered by Law 115/97, of September 19th sets out in article 3 that the education system should be organised in such a way as to contribute to pupils' development in terms of personalities, attitudes and sense of citizenship, leading to a conscious reflection on spiritual, aesthetic, moral and civil values, thus assuring a balanced civil development. In 1997 central, regional and local administrations and/or non-governmental organisations (NGOs), created various infrastructures aimed at providing environmental information, awareness and education to citizens. These bodies, together with other local entities, promote activity programmes on various environmental issues, contributing to the decentralisation of access to information. Environmental awareness is promoted through campaigns or organised events. Awareness raising is almost always linked to provision of information and normally activities call for the response or active participation of citizens. The development of awareness raising campaigns also allows for the creation of partnerships between public administration and other entities, specifically NGOs.

8.2 Primary, Secondary and Higher Education

According to the Framework Law, the Education System includes kindergarten, school education and out of school education.

School education includes Primary, Secondary and Higher Education as well as special free-time activities.

Primary education aims to provide all individuals with a general preparation: it begins at around the age of six, lasts nine years and includes 3 sequential cycles, the first of which lasts four years, the second lasts two years and the third, three years. It is public, obligatory and free-of-charge.

Secondary education follows the obligatory primary education and is composed of a single three-year cycle (10th, 11th and 12th years).

Since the late 1970s, environmental themes have been introduced in school programmes. From the 1980s, the possibility was established for a more formal involvement by schools in project methodologies of predominantly environmental themes, both in terms of studies and local activities.

In 2001/2002, new Primary Education curriculum programmes were implemented with the introduction of new subjects, new extra-curricular activities and transversal areas. Especially significant in their contribution to environmental education, in the context of education for sustainability, are the curricular initiatives, "Citizenship Education", the "Project Area" and "Civic Education".

Other curricular subjects that reinforce the relationship between Science, Technology, Society and the Environment (CTS/A), in an approach that emphasises economic and technological development, replaced the programmes for Geography, Natural Sciences, Physics and Chemistry. Themes related to adequate management of natural resources –

water, oceans, fisheries, atmosphere, biodiversity and forestry – were taken into account in these curricular programmes and can be approached transversally in all the subjects.

Citizenship Education was introduced throughout the curriculum in Primary and Secondary education. The subjects' programmes are aimed at developing transversal competencies in various areas of citizenship education, specifically Environmental, Road Safety, Consumer, Health and Media Education. In the specific case of sciences, the CTS/A approach is favoured, where the relationship between Science, Technology, Society and the Environment forms the framework of the programmes' themes.

The Technological Course on Spatial and Environmental Planning was introduced in the context of the Secondary Education reform process. It aims to train technical assistants in Spatial Planning, Management, Education and Environmental Tourism.

As an example, climate change is specifically covered in the following subjects:

- **Geography (3rd cycle of primary education)**
  - **Theme 9** "Environment and Society". Global Warming – Climate Change
- **Physical/Natural Sciences (3rd cycle of Primary education)**
  - **Theme 4** Sustainability on Earth: Global Change
    Forecast and description of atmospheric conditions; the impact of human activity on the earth's atmosphere and climate. Activity suggestion: taking into account the need to extract, transform and use natural resources and the advantages and disadvantages of doing so, students should reflect upon and suggest proposals for rational management of resources, later comparing them with current initiatives on this subject – for example the Kyoto Protocol, signed on December 11th, 1997. Debate the controversy around this Protocol.
- **Physics and Chemistry (Secondary Education, 10th year)**
  - **Physics Unit 1** From Sun to Warming
    Activities outside the classroom are suggested, where students can see the impact of the greenhouse effect and the negative consequences of the changes provoked to the atmosphere by human activity.
  - **Chemistry Unit 2** Atmosphere and Radiation
- **Geology (Secondary Education, 12th year)**
  - **Theme** The Earth, Yesterday, Today and Tomorrow
    Humans as agents of climate change, global warming, environmental concerns in geological terms
- **Geography (Secondary Education, 12th year)**:
  - **Sub-theme** The Greenhouse Effect and Global Warming
    Debates are proposed on the resolutions of world conferences
- **Biology (Secondary Education, 12th year)**
  - **Unit 5** Preserve and Recover the Environment: the Greenhouse Effect
- **Chemistry (Secondary Education, 12th year)**
  - **Unit 2** Fuels, Energy and the Environment
    Various environmental aspects are covered, such as the identification of environmental problems related to atmospheric pollution (particles, CO_2, SO_x, NO_x and CO_x emissions and related chemical reactions), specifically climate change as provoked by the oil industry and by fuel combustion

Source: ME, 2005

The Ministry of Education (ME), in partnership with the Ministry of the Environment, Spatial Planning and Regional Development (MAOTDR), Municipalities, Universities and other governmental and non-governmental institutions, have developed various Environmental Education projects in schools including:

- Lisbon is Our Home, in partnership with the City of Lisbon, which aimed to train teachers and provide didactic material;
- Environmental Itineraries Project, in partnership with the Regional Directorate for the Environment of the Azores;
- Participation in the National Commissions for the Eco-Schools Programme (support for primary school projects) and the Young Reporters for the Environment Project (secondary schools), run by ABAE/FEE (Foundation for Environmental Education) Portugal.

Since 1997, within the scope of the ME and the MAOTDR Cooperation Project, teachers have been appointed to coordinate school projects for environmental education. The Institute for the Environment (IA) supports projects in kindergartens, primary and secondary schools. The pool of teachers coordinating the Environment Education School Projects is currently composed of 10 members, 3 of which are responsible for organising the "Ecotecas" (Eco-libraries) of Macedo de Cavaleiros, Serra de Aire e Candeeiros (Porto de Mós) and Olhao (responsibility for materials promoting environmental education is shared with the IA), the remaining 7 organisations responsible for coordinating environmental education are Environmental Non-governmental Organisations (ENGOs), specifically: QUERCUS (National Association for Nature Conservation - Ourém), PATO (Association for the Protection of "Paúl de Tornada"), League for the Protection of Nature – Alentejo (Evora), FAPAS (Fund for the Protection of Wildlife - Oporto), ASPEA (Portuguese Association of Environmental Education – Aveiro Delegation), ABAE/FEE Portugal and GEOTA (Research Group on Spatial Planning and the Environment - Lisbon).

On December 16th, 2005, following the public presentation of the Portuguese version of the UNECE Strategy for Education for Sustainable Development, a new protocol was signed between the MAOTDR and the ME, aimed at the promotion and execution of Environmental Education for Sustainability, in kindergartens, primary and secondary education systems, renewing and updating the one previously in force (Table 38).

Table 38. Number of teachers allocated annually for the promotion and implementation of Environmental Education for Sustainability in Kindergartens, Primary and Secondary Education systems (2001-2005)

Year	2001	2002	2003	2004	2005
Number of teachers	12	12	11	10	10

Source: ME, 2005

During the 2003/04 school year, climate change was proposed to the teachers as theme for projects, awareness raising activities, training and other initiatives. A two-day training course was provided for these teachers in November 2003, at the IA.

Within the context of this Protocol, the following actions were developed:

- **Olhao Ecoteca (library facility)**
  - Support and collaboration in the ZOOM Project at a local and regional level
  - Organization and development of thematic awareness raising and debating sessions
- **Macedo de Cavaleiros Ecoteca**
  - Presentations to local communities
- **Porto de Mós Ecoteca**
  - "The Forest and Life" Project with the Porto de Mós Cluster of schools

- 2nd National Geography Fortnight – Awareness raising sessions and debates, final exhibition of Secondary Education projects.

ZOOM Project 2003

A European Project, part of the Mobility theme in which Portugal participated with 46 Primary schools, distributed across 15 public administration bodies which also participated in the European Car-free Day/European Mobility Week initiative. This involved 3326 children who collected approximately 16 000 ecological footprints which were sent to the project's European Coordination.

Project ZOOM 2004/2005

The Municipality of Ílhavo continued this project (*Ílhavo on the way to Brussels)* for the second consecutive year, adapting the project image and customising it to the local conditions. Once again, results were very positive. Nine of the Municipality's schools, 38 classes and a total of 752 students participated, largely surpassing the original objective which was to collect 1899 ecological footprints, by achieving 6957.

Source: ME, 2005

Carbon Force 2005 is an example of one of the projects developed in collaboration with schools.

Recently the IA signed a protocol with the Higher Technical Institute (IST) for the creation of an integrated education project on climate change and CO_2 balance, aimed at schools. It includes educational activities, such as games simulating the trade in gas emissions. It is an awareness raising and action pilot project which enables schools to monitor and reduce the emission of gases which contribute to climate change, creating and putting into practice sustainable energy and transport policies.

Figure 60. Carbon Force Project Leaflet

Source: http://www.carbonforce.net

8.3 Training

The ME's Directorate-General for Innovation and Curricular Development has been coordinating teacher training initiatives on the new programmes, in which Citizenship Education is considered a transversal approach which includes the environment, road safety, consumption, health, media and human rights. In relation to training for science projects, the focus was on the CTS/A approach as a framework for citizenship education through science. The following are examples of teacher training programmes:

- **XV National Meeting on Environmental Education**, promoted by the IA and Gaia Biological Park, 2-5 October 2004 in Castelo de Vide, under the Climate change and Eco-tourism theme, with 280 participants;
- **Training sessions organised by Teacher Training Centres** including information and pedagogic support on climate change.

During the 2004/2005 school year, the theme proposed to teachers for inclusion in projects, awareness raising actions, training and other activities was Sustainable Development and Climate Change.

Although these projects and activities did not specifically cover the climate change theme, most touched on the issue, linked to other areas such as biodiversity, water management, energy consumption and coastal protection.

In addition to the formal education process, the production of pedagogical materials, support and information for students and teachers is promoted by publishers and developed by NGOs. Hence, various Environmental Education projects in schools, coordinated by the ME in collaboration with MAOTDR, count on the support of Local Councils and Universities as well as other governmental institutions and NGOs.

Under the scope of MAOTDR, training actions are developed for the armed and security forces, aimed at teaching specific environment skills, including:

- **Courses on Environment** – Concepts and factual information on climate change aimed at training agents for the Nature and Environment Protection Service/National Guard (7 courses developed between 2001 and 2005, with the participation of a total of 400 trainees);
- **Training Course for Trainers** - Concepts and factual information on climate change for Police force trainers (held in 2005 with the participation of 30 trainees);
- **Environmental Training Courses for Portuguese Navy Trainers** (2 courses per year since 2000, including approximately 30 trainees per course);
- **Santa Margarida Military Camp 2005 Environmental Week**, aimed at trainers (approximately 100 participants including officers and other Army trainers);
- **Training Courses for the Portuguese Air Force Trainers** (2 courses in 2004 and 2005).

8.4 Raising Public Awareness

The IA has produced the following didactic and awareness raising material that specifically covers the climate change theme:

- **Itinerant Exhibition on climate change - "The Future of our Climate"**: 9 informative panels and a brochure guide aimed at the general public and Secondary Education pupils as well as Primary Education (3rd cycle) pupils (Figure 61).

- Various printed materials, in particular the informative leaflet on Climate Change, the CD rom, **CLIM@lerta** with didactic games for children aged 6 to 12 (1st and 2nd Cycles of Primary Education). The game allows users to select any of the following 3 areas: transport, energy and forestry (Figure 62 and Figure 63).

Figure 61. "The Future of Our Climate" exhibition panels

Source: IAb, 2004

Figure 62. Menu for the Clim@lert game

Source: IAa, 2004

Figure 63. Transport and Forestry sections of Clim@lerta game

Source: IAa, 2004

The Azores was responsible for the publication entitled *The Azores Atmosphere within the Context of Global Changes: Current Status.*

ENGOs have developed various awareness raising projects related to climate change. On a wider scale, the activities of various municipal energy agencies promote the best practices leading to a reduction of GHG emissions, within a context of Rational Use of Energy.

- **AGENEAL (Almada Municipal Energy Agency)**
  - **Observatory for greenhouse gases emissions of Almada:** this activity includes the continuation of the work that began with the development of the *Greenhouse Gas Emissions Inventory in the Almada District* project.
  - **Info-Energy Actions:** a public service that aims to clarify questions on energy-related topics (e.g. use of solar energy, domestic heating systems, aspects associated to the construction of homes, among others). Whenever relevant, AGENEAL reinforces its work with Almada Council's teaching community, developing sessions on energy aimed at pupils in all levels of education.
  - **Promotion of sustainable mobility:** structured and continued activities that aim to raise awareness on sustainable mobility in Almada. Some of the key activities carried out include various events in the frame of European Mobility Week/European Car-free Day. During the European Mobility Week there were two themed days, specifically *Roads to Play On*, during which AGENEAL organised a demonstration and test of vehicles which run on alternative fuels, a workshop on solar furnaces and sun dials and the *Eco-driving* day.

Source: AGENEAL, 2005

- **Energaia (Gaia Municipal Energy Agency)**
  - **BELIEF (Building in Europe Local Intelligent Energy Forums):** project intended to promote and increase public participation in energy, aiming in this way to establish partnerships that lead to the creation of sustainable energy communities.
  - **Energy Portal:** aims to develop an Internet site where users can find all energy-related information, products and services.
  - **European DISPLAY Campaign:** a European awareness raising project for schools, local authorities and municipalities in general on the rationalisation of energy and water consumption in buildings.
  - **eds.NORTE:** promotion of sustainability energy in Northern Portugal. This is especially aimed at local authorities, through the production and dissemination of high quality informative materials on municipal management of energy. This Project, developed with the support of the Commission for Regional Coordination and Development – North, is divided into seven actions
    - **Action 1** – Energy efficiency in buildings
    - **Action 2** – Energy renewal using organic residues
    - **Action 3** – Best energy practices for SMEs and Commerce
    - **Action 4** – Eco-efficient Industrial Plants
    - **Action 5** – eds.NORTE Portal
    - **Action 6** – Promotion of the Project and dissemination of the results
    - **Action 7** – Commission for the follow-up of the initiative
  - **Information and awareness raising:** regular information and awareness raising activities included the production and distribution of various publications, highlighting the Vila Nova de Gaia Energy Framework, the Save Energy at Home and the Renewable Energy in Vila Nova de Gaia.
  The contents are available at http://www.energaia.pt.

  Source: Energaia, 2005

- **ARENA (Regional Energy Agency of the Azores Region)**
  - **Energy Efficiency Campaign:** taking into account that the Azores is totally dependant on external supplies of fossil fuels and that the electricity consumed in the region mainly originates from these fuels, the efficient use of energy not only aims to meet the objectives defined by the Kyoto Protocol and to contribute to the competitivity of companies in the region, it is also a way in which to decrease its aforementioned dependence. The Energy Efficiency in the Azores Region Project was developed to raise awareness of the general public and in particular companies, on a more rational and efficient use of energy, a scarce and costly resource. Responding to the importance of the transport sector in energy consumption in the Azores, the campaign was reinforced with a new phase aimed mainly at car drivers. In general terms this consisted of the production and airing of two TV commercials, the production and mailing of 83 000 brochures, 35 outdoor posters shown in advertising boards in Sao Miguel, the production and airing of two radio spots, and the creation and publication of press advertisements. Two television commercials were produced, (a 20 second and a 30 second versions) and were aired for a month each, the radio spots were aired on 8 radio stations in the Azores and the press advertisements were printed in 8 of the Azores newspapers.
  - **ERAMAC-1** –Maximize the Penetration of Renewable Energies and Rational use of Energy in the Macaronesian Islands.

  Source: Arena, 2005

Regarding the trend in public opinion on environmental issues, two national surveys – The Portuguese and the Environment, were carried out in 1997 and 2000. This was developed within the framework of Project OBSERVA – Permanent Observatory on the Environment, Society and Public Opinion, by university institutions.

The objective of these surveys was to determine attitudes, opinions and expectations of various groups of the population based on a vast range of environmental issues.

The most significant findings, relative to climate change, are the following:

- 62% of respondents recognise that it is a serious problem which needs to be addressed;
- only 8% believe that it is a problem which has been exaggerated;
- climate change is 7th on the list of environmental concerns;
- nearly half of the population cannot distinguish between the greenhouse effect and the destruction of the ozone layer;
- the logic behind energy efficiency is money-saving rather than saving resources or reducing pollution;
- there are many doubts and lack of knowledge regarding the use of alternative energy in the future; and
- there is little will to adopt more environmentally-friendly means of transport or giving up single transport means, this is sometimes associated to the variable distribution of public transport systems across the country.

Fuel Economy Guide

Regarding climate change and consumer awareness raising, Decree Law 304/2001, of 26 November, sets out an information system whereby drivers of new cars have access to information allowing them to make an informed choice on fuel consumption and CO_2 emissions. All promotional materials on new cars must include information on fuel consumption and CO_2 emission. The *Fuel Economy Guide* is a publication by the Directorate-General for Driver Licensing (DGV) which compiles annual data regarding the official fuel consumption and specific CO_2 emission levels, for each new car.

Source: adapted from DGV, 2005

Activities developed by the Directorate-General for Land and Water Transport

Greenhouse gas emissions reduction in the road transport sector will only be achieved by replacing a significant part of the national vehicle fleet with cars with lower levels of emissions, as well as by promoting and building the incentive for the increased use of public transport, leading to a reverse in the growing trend of single transport seen in Portugal in recent years. The use of single transport means has increased from 26% to 46% over the past 10 years, at the cost of a decrease in public transport from 51% to 36%.

Therefore the Directorate General for Land Transport (DGTT) has started to promote the introduction of environmental-friendly public transport vehicles, specifically vehicles powered by recent diesel technology, and others that run on alternative energy such as natural gas, hybrid and electric vehicles. These activities have been supported by studies on the re-organisation of traffic in urban areas that aim to promote the public transport of passengers, in comfortable conditions which meet their current demands, thus providing sustainable mobility conditions in the city centres.

With regard to electric vehicles, the DGTT signed a protocol with the Portuguese Association for Electric Vehicles (APVE) and has developed a series of demonstration activities with electric mini-buses in almost all of Portugal's main cities.

This began in June 2002 with the arrival of two electric mini-buses that were presented at the Exponor fair and at the Municipal Urban Transport Services in Coimbra. The demonstration activities began almost immediately in Oliveira de Azeméis, Aveiro and Viseu, covering urban routes in a total of 25 cities. Given their size, the fact that the mini-buses

have no emissions and are silent make these vehicles ideal for inner city areas and contribute to a higher use of public transport.

Given the great interest raised by the DGTT demonstrations new urban routes were created, in collaboration with APVE and the local authorities, for the electric mini-buses in the 5 cities where the demonstrations were carried out - Coimbra, Bragança, Portalegre, Viseu and Viana do Castelo. Regular routes using the electric mini-buses are already in place in these cities with links to the suburban routes. This has contributed to a high quality public transport service, dissuading single transport means.

Regarding natural gas, transport operators have shown significant interest especially in Oporto where the Oporto Public Transport System (STCP) already has 225 buses which run on natural, compressed gas (CNG – Compressed Natural Gas), corresponding to 50% of its fleet.

Lisbon, Aveiro and Braga also have CNG vehicles in their public transport fleets. The DGTT developed a demonstration initiative with the support of the Portuguese Association for Natural Gas Vehicles (APVGN) to promote hybrid cars (petrol and natural gas) to taxi operators.

However, the growth of this sector is conditioned by difficulties in CNG supply given there are only four private fuelling stations in the whole country and by the limited number of vehicles available in the market.

With these awareness raising and demonstration activities, the DGTT aims to contribute to more sustainable urban mobility through a more diversified transport energy matrix and to promote the use of environmentally friendly vehicles.

Source: DGTT, 2005

8.4.1 Access to Information and Public Participation

In January 2005 the IA published the 1st National Report on the Aarhus Convention, on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters. This Report refers to measures adopted to assure that the MAOTDR bodies and their employees support and assist the general public. The MAOTDR bodies have Information and Documentation Centres with the skilled and experienced staff necessary to ensure that users receive all the support and help they need when researching information. These bodies also have websites where information is provided on the areas of their competencies, and procedures to respond to e-mail requests. Within this framework, MAOTDR has supported actions promoted by civil society, namely NGOs, aimed at providing citizens with access to information on the environment.

The Institute for the Environment website contains information on the national GHG inventory (inventory data as well as the annual report explaining the methodologies and information base), the National Climate Change Programme (PNAC) and Portugal's participation in the EU Emissions Trading Scheme (EU-ETS).

In 2002 and 2003 the IA website had a daily average of 586 and 865 visits respectively. In 2003 there were 3820 e-mail requests; of these, 52% were requests for information, 26% were suggestions and 7% were comments.

The National Climate Change Programme (PNAC) and the National Allocation Plan (PNALE) were both subject to consultation processes.

As a result of what is set out by the PNAC 2001, presented to the public on December 18th,, was drawn up in accordance with the Council of Ministers Resolution 59/2001, of May 30th. The IA promoted three public sessions during the months of January and February 2002; results were included in the PNAC 2001 after analysis by the Commission for Climate Change (CAC).

As a result of the work initiated in the PNAC 2001, sectoral Reference Scenarios were identified, from which GHG emissions reduction efforts would be determined for the various sectors of the economy. This group of sectoral documents was subject to public discussion in February 2003.

Additional policies and measures were considered to guarantee Portugal's fulfilment of the Kyoto Protocol, with a view to updating PNAC as well as its effective implementation. On December 18th, 2003 the Public Discussion period began with a presentation of these additional measures. The documents were disseminated and made available from the IA website. Between December 18th 2003 and February 2004, comments and suggestions were received and summarised in the respective public discussion report.

The National Allocation Plan (PNALE) was determined in the frame of Directive 2003/87/CE of the European Parliament and of the Council of 13 October, creating a GHG emissions trading scheme within the EU. With the support of CAC, a working group was formed to develop the PNALE proposal for the period 2005-2007. This document was subject to public discussion and was publicly presented on March 17th, 2004. The public discussion on the document ran until March 2004.

Regarding Public Consultation, contributions were received from:

- 3 business associations;
- 1 NGO;
- 12 companies and other entities;
- 1 individual.

All received individual replies from the working group, explaining and justifying the options adopted.

8.4.2 Involvement of Environmental Non-Governmental Organisations

Environmental NGOs in Portugal are legally defined according to Law 35/98, of June 18th. Article 14(2), establishes that the IA is responsible for providing financial support to the ENGOs and other equivalent organisations. Decree Orders 478/99, of June 29th and 71/2003, of January 20th, regulate the National Registry of the ENGOs and Equivalent (RNOE). Steps needed for establishment, modification, suspension and annulment of NGOs, as well as financial support received, are published in the *Diário da República*. Information regarding registered and active NGOs is available on the internet (http://www.iambiente.pt/docs/5026/RNOE_1205). To date there are 135 registered organisations.

The MAOTDR currently has two means of financial support:

- Programme for the Support of Environmental and Sustainable Development Activities (PAAADS): it funds environmental and sustainable development actions. Registered organisations such as Environmental Protection Associations, their federations, NGOs, universities, Higher Education and Polytechnic Institutes can apply for funding; and

- ENGO Financial Support Programme (PAFOE): exclusively for ENGOs and Equivalents registered at the RNOE. It aims to reinforce the capacity for participation and the development of projects or actions, providing three different types of funding. In 2004, 2005 and 2006, the main funding priorities were policies and measures to respond to climate Change.

In 2003 these two funding programmes supported 145 projects, involving 50 organizations amounting to about € 257 621. In 2004, 111 projects were supported, amounting to about € 221 041; in 2005, 134 projects were supported to a sum of about € 237 156.

Table 39 lists financial support provided by the IA through PAFOE.

Table 39. Support for information, awareness raising and environmental education activities about climate change (2004-05)

Organisation	Year	Activity or Project	Description of Activity/Project	Funding (Euros)
Portuguese Association of Environmental Education (ASPEA)	2004	Climate change: education and health network – the future is also what we want it to be	Aims to raise the awareness of climate change amongst the education community in the centre of Portugal, in schools and other educational establishments through the development of informative material and the dissemination of information by mail and e-mail.	5728.39
Portuguese Confederation of the Associations for the Defence of the Environment (CPADA)	2004	Study Cycles on climate change[110]	Aims to create groups of citizens, at a regional level, to debate specific environmental problems of their region, focusing on those related to climate change. These discussions should lead to an increase in the population's awareness on related problems and lead to the promotion of individual initiatives to reduce greenhouse gas emissions.	3304.90
Fund for the Protection of Wildlife (FAPAS)	2004	Let's take care of the Atmosphere	The Project consists on developing school activities and the production of informative materials to raise awareness on climate change, focusing on the degradation of ecosystems and the loss of biodiversity, as well as the contributions that can be made to halt the climate change process, such as working on sand-dune ecosystems.	8228.85
Research Group on Spatial Planning and the Environment (GEOTA)	2004	Integrated actions for sustainable development – campaign for health, environment and climate change	This Project consists of 10 thematic activities covering various environmental areas, focusing on Health, Environment and Climate Change. It aims to promote information, raise awareness and carry out monitoring and demonstration activities. It includes participation in policy and strategy formulation relating to hydro resources in Portugal, following marine management policies, and participation in energy policy, namely through the development of activities promoting the rational use of energy.	3616.44
Youth Association for the Environment and Adventure (ONDA VERDE)	2004	Campaign to build awareness on climate change	The aim is to give classes on the "climate change – causes and effects" theme, in Paredes Council primary and secondary schools. 36 themed sessions were held with the participation of approximately 2,000 students.	1510.10

[110] Actions and Projects which have not been concluded yet.

Organisation	Year	Activity or Project	Description of Activity/Project	Funding (Euros)
QUERCUS – National Association for Nature Conservation	2004	EcoHome	This Project aims to be an important instrument in raising citizens and institutions awareness on energy, air quality, climate change, as well as on the reduction of dependence on fossil fuels, privileging the management for the demand for alternative energy sources. The Project started with research to identify on the most relevant consumers. Results showed that they were domestic consumers. Therefore it was considered very important to find a way in which to communicate to citizens that would motivate them to reduce their energy consumption at home and in doing so, reduce their costs with energy. On the whole, they would be contributing to national efforts to reduce energy dependence and consequently contribute to an improvement in air quality, positively impacting climate change and their own quality of life. An internet site called Casa Virtual - Virtual Home (http://www.ecocasa.org/) was created where the user can simulate consumption in their home and test more advantageous possibilities.	8092.62
Portuguese Association of Environmental Education (ASPEA)	2005	Guardians of the Environment – Discover schools under the effect of climate change	This project's aim is to promote in each school, the creation of the "Guardians of the Environment", groups of pupils who will promote behavioural changes regarding practices that harm the environment, specifically the excessive consumption of energy.	2709.28
EURONATURA – Centre for Environmental Law and Sustainable Development	2005	Management of Companies: Response Rate	This project's objective is to create and apply an index to evaluate responses from a group of Portuguese companies, including those that are currently not covered by the European Union's Emissions Trading Scheme, challenging climate change. This rate will be used to highlight the more proactive companies that surpass the fulfilment of legal obligations. The aim is to use this index as a useful tool to enable consumers, investors, suppliers and the general public to make more informed choices. The index could also be used as a benchmark tool for company managers to compare their companies with other direct competitors and act accordingly. Due to all of this, it is believed that this index will become an awareness raising instrument "par excellence".	2709.28
Mértola Municipal Association for the Study of the Defence of Natural and Cultural Heritage (ADPMértola)	2005	Protect the forest, fight against global warming[111]	On the one hand, this project aims to alert on the consequences of forest fires on the atmosphere, a process which accelerates global warming. On the other hand it aims to stimulate forest protection in order to reduce forest fires. Therefore, we propose developing environmental education actions in schools that promote behavioural change to prevent the occurrence of forest fires contributing to a reduction in the concentration of gases in the atmosphere.	2988.76
Flamingo Group – Association for the Protection of the Environment	2005	Climate change – A problem to be debated[112]	Aims to demonstrate that human activity is the main responsible for climate change, contributing to the increase in the concentration of gases that lead to the atmosphere's greenhouse effect. In order to so, the proposal is to carry out awareness raising actions through the discussion of specific problems and their most adequate solutions, aimed at stimulating the target population to change their attitudes. This discussion will reinforce man's important role as an agent for the desired change, through the resolution of these issues.	2709.28

[111] Actions and projects not yet concluded.

[112] Actions and projects not yet concluded.

Given their areas of activity, ENGOs play an extremely active role in public participation processes and an equally relevant role informing on environmental issues.

Other projects led by ENGOs:

- ABAE/FEE:
  - **Eco-Schools Programme** (405 primary schools and kindergartens; 20 000 pupils, 410 teachers and 123 Local Authorities)
  - **Young Reporters for the Environment Project** (55 secondary schools, 1115 pupils and 130 teachers)
  - **Awareness raising session with the Sintra Municipality – Energy and Transport** (160 participants)
- **ASPEA**:
  - **Climate change Programme – networking education, health and the environment.** Awareness raising sessions on the Greenhouse Effect and Energy and the Environment
- **GEOTA**:
  - **2003 Coastwatch Project** (4500 participants and 800 Km of monitored coast)
  - **Coastwatch Seminar: Management of the coastline, Impacts on the Coast and Climate Change** (aimed at teachers and the public in general)
  - **Awareness Raising Sessions – Environmental Degradation on the Coast: Consequences of Climate change**
- **PATO:**
  - **Cycle of themed conferences aimed at the population of the western region – Climate change – The Coast under Threat** (70 participants)
- **FAPAS**:
  - **Nature Preservation Study Days (teachers' training) – Let's look after the Atmosphere Project** (2300 pupils)
- **APDA**:
  - **Training activity for Secondary School teachers** (22 participants)
- **LPN – Alentejo**:
  - **Film sessions and debates** (70 participants)

8.5 Participation in International Activities

The ME participates in the Education for Values programme, with the Ibero-American Organisation. Its main objective is to promote the values, attitudes, behaviour and concepts from an ethical perspective which unites the local and global dimensions of this theme. Within this context, the ME also collaborates in the European Council's and the EU's Education for Citizenship project.

The IA has financed, under PAAADS, the participation of ENGOs at various national and international events which contribute to the increase in the capacity of work done by the benefiting entities (Table 40).

Table 40. Support to the participation in national and international events that contribute to the building of capacity of the beneficiary organisations (2000-2005)

Association	Year	Action	Action's Description	Funding (Euros)
QUERCUS – National Association for Nature Conservation	2000	6th Conference of the Parties to the Climate Change Convention (COP6)	The Hague, Amsterdam, November 13th to 24th	987.98
QUERCUS – National Association for Nature Conservation	2001	Second part of the 6th Conference of the Parties to the Climate Change Convention (COP6bis)	Bonne, Germany, July 16th to the 27th	703.31
QUERCUS – National Association for Nature Conservation	2001	7th Conference of the Parties to the Climate Change Convention	Marrakech, Morrocco, October 29th to November 9th	404.03
EURONATURA – Centre for Environmental Law and Sustainable Development	2001	7th Conference of the Parties on the Climate Change Convention	Marrakech, Morocco, October 29th to November 9th	1326.78
QUERCUS – National Association for Nature Conservation	2002	8th Conference of the Parties to the Climate Change Convention	New Delhi, India, October 23rd to November 1st	2500.00
QUERCUS – National Association for Nature Conservation	2003	9th Conference of the Parties to the Climate Change Convention	Milan, Italy, December 5th to the 12th	515.71
QUERCUS – National Association for Nature Conservation	2004	10th Conference of the Parties to the Climate Change Convention	Buenos Aires, Argentina, December 6th to the 17th	1580.20
QUERCUS – National Association for Nature Conservation	2005	11th Conference of the Parties to the Climate Change Convention / 1st Meeting of the Parties to the Kyoto Protocol	Montreal, Canada, November 28th to December 9th	1345.15

Source: IA, 2005

ANNEXES

Annex 1.
National Greenhouse Gas Emissions Inventory (1990-2004)

Table 41 . Summary report for CO_2e emissions, in 1990 (2006 Submission)

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Portugal
1990
Submission 2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**46.425,70**	**11.379,78**	**5.378,56**	**0,00**	**0,00**	**1,82**	**63.185,86**
1. Energy	**39.087,12**	**564,93**	**519,85**				**40.171,90**
A. Fuel Combustion (Sectoral Approach)	38.963,28	463,72	519,85				39.946,85
1. Energy Industries	15.944,40	4,33	61,04				16.009,77
2. Manufacturing Industries and Construction	9.157,88	38,03	67,25				9.263,15
3. Transport	9.827,75	72,90	154,63				10.055,28
4. Other Sectors	4.025,13	348,30	236,92				4.610,35
5. Other	8,13	0,15	0,02				8,29
B. Fugitive Emissions from Fuels	123,83	101,21	0,00				225,04
1. Solid Fuels	8,65	66,02	0,00				74,66
2. Oil and Natural Gas	115,19	35,19	0,00				150,38
2. Industrial Processes	**4.048,66**	**9,08**	**566,68**	**0,00**	**0,00**	**1,82**	**4.626,24**
A. Mineral Products	3.384,40	0,76	0,00				3.385,16
B. Chemical Industry	634,38	8,32	566,68	0,00	0,00	0,00	1.209,38
C. Metal Production	29,44	0,00	0,00		0,00	0,00	29,44
D. Other Production	0,44						0,44
E. Production of Halocarbons and SF_6				0,00	0,00	0,00	0,00
F. Consumption of Halocarbons and SF_6				0,00	0,00	1,82	1,82
G. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00
3. Solvent and Other Product Use	**219,71**		**0,00**				**219,71**
4. Agriculture	**0,00**	**4.071,72**	**3.805,93**				**7.877,64**
A. Enteric Fermentation		2.621,88					2.621,88
B. Manure Management		1.176,37	563,37				1.739,74
C. Rice Cultivation		255,71					255,71
D. Agricultural Soils [2]	NE	0,00	3.224,90				3.224,90
E. Prescribed Burning of Savannas		0,00	0,00				0,00
F. Field Burning of Agricultural Residues		17,76	17,66				35,42
G. Other		0,00	0,00				0,00
5. Land-Use Change and Forestry [1]	**3.060,10**	**153,59**	**15,59**				**3.229,28**
6. Waste	**10,10**	**6.580,46**	**470,52**				7.061,08
A. Solid Waste Disposal on Land	0,00	3.891,80					3.891,80
B. Wastewater Handling		2.688,62	469,40				3.158,02
C. Waste Incineration	10,08	0,01	0,37				10,47
D. Other	0,02	0,03	0,74				0,79
7. Other *(please specify)*	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
							0,00
Memo Items:							
International Bunkers	**3.170,55**	**1,58**	**26,54**				**3.198,67**
Aviation	1.390,67	0,98	12,46				1.404,11
Marine	1.779,89	0,60	14,08				1.794,56
Multilateral Operations	**NO**	**0,00**	**0,00**				**0,00**
CO_2 Emissions from Biomass	**10.570,89**						**10.570,89**

[1] For CO_2 emissions from Land-Use Change and Forestry the net emissions are to be reported. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).
[2] See footnote 4 to Summary 1.A of this common reporting format.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	Net CO_2 emissions / removals	CH_4	N_2O	Total emissions
Land-Use Change and Forestry	CO_2 equivalent (Gg)					
A. Changes in Forest and Other Woody Biomass Stocks	0,00	0,00	0,00			0,00
B. Forest and Grassland Conversion	0,00		0,00	0,00	0,00	0,00
C. Abandonment of Managed Lands	0,00	0,00	0,00			0,00
D. CO_2 Emissions and Removals from Soil	0,00	0,00	0,00			0,00
E. Other	0,00	0,00	736,54	153,59	15,59	905,72
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	0,00	0,00	3.060,10	153,59	15,59	3.229,28

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [a]	59.956,57
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [a]	63.185,86

[a] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land-Use Change and Forestry.

Source: IAb, 2006

Table 42. Summary report for CO_2e emissions, in 2004 (2006 Submission)

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Portugal
(Sheet 1 of 1) 2004
Submission 2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**62.476,68**	**12.372,35**	**6.245,76**	**368,41**	**0,00**	**3,44**	**81.466,64**
1. Energy	**58.962,77**	**864,06**	**956,96**				**60.783,79**
A. Fuel Combustion (Sectoral Approach)	58.129,44	448,51	956,96				59.534,90
1. Energy Industries	21.256,14	6,73	107,30				21.370,17
2. Manufacturing Industries and Construction	10.667,99	56,87	95,66				10.820,53
3. Transport	19.373,55	68,14	582,20				20.023,89
4. Other Sectors	6.831,76	316,76	171,79				7.320,31
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	833,34	415,55	0,00				1.248,89
1. Solid Fuels	0,00	0,00	0,00				0,00
2. Oil and Natural Gas	833,34	415,55	0,00				1.248,89
2. Industrial Processes	**6.058,47**	**12,95**	**604,65**	**368,41**	**0,00**	**3,44**	**7.047,92**
A. Mineral Products	4.182,47	1,79	0,00				4.184,26
B. Chemical Industry	1.837,44	11,17	604,65	0,00	0,00	0,00	2.453,26
C. Metal Production	38,12	0,00	0,00		0,00	0,00	38,12
D. Other Production	0,44						0,44
E. Production of Halocarbons and SF_6				0,00	0,00	0,00	0,00
F. Consumption of Halocarbons and SF_6				368,41	0,00	3,44	371,85
G. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00
3. Solvent and Other Product Use	**320,15**		**0,00**				**320,15**
4. Agriculture	**0,00**	**4.380,08**	**4.065,29**				**8.445,37**
A. Enteric Fermentation		3.012,33					3.012,33
B. Manure Management		1.157,50	577,26				1.734,76
C. Rice Cultivation		193,97					193,97
D. Agricultural Soils [2]	NE	0,00	3.471,81				3.471,81
E. Prescribed Burning of Savannas		0,00	0,00				0,00
F. Field Burning of Agricultural Residues		16,28	16,21				32,49
G. Other		0,00	0,00				0,00
5. Land-Use Change and Forestry [1]	**-3.194,84**	**109,54**	**11,12**				**-3.074,18**
6. Waste	**330,12**	**7.005,72**	**607,75**				7.943,60
A. Solid Waste Disposal on Land	0,00	4.755,87					4.755,87
B. Wastewater Handling		2.248,91	580,38				2.829,29
C. Waste Incineration	330,12	0,90	26,18				357,21
D. Other	0,00	0,04	1,19				1,23
7. Other *(please specify)*	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
							0,00
Memo Items:							
International Bunkers	**4.213,72**	**1,71**	**35,82**				**4.251,25**
Aviation	2.374,25	1,09	21,27				2.396,61
Marine	1.839,48	0,62	14,55				1.854,64
Multilateral Operations	**NO**	**0,00**	**0,00**				**0,00**
CO_2 Emissions from Biomass	**11.534,64**						**11.534,64**

[1] For CO_2 emissions from Land-Use Change and Forestry the net emissions are to be reported. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).
[2] See footnote 4 to Summary 1.A of this common reporting format.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	Net CO_2 emissions / removals	CH_4	N_2O	Total emissions
Land-Use Change and Forestry	CO_2 equivalent (Gg)					
A. Changes in Forest and Other Woody Biomass Stocks	0,00	0,00	0,00			0,00
B. Forest and Grassland Conversion	0,00		0,00	0,00	0,00	0,00
C. Abandonment of Managed Lands	0,00	0,00	0,00			0,00
D. CO_2 Emissions and Removals from Soil	0,00	0,00	0,00			0,00
E. Other	0,00	0,00	476,01	109,54	11,12	596,67
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	0,00	0,00	-3.194,84	109,54	11,12	-3.074,18

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [a]	84.540,82
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [a]	81.466,64

[a] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land-Use Change and Forestry.

Source: IAb, 2006

Table 43. Emission trends (CO_2) (2006 submission)

TABLE 10 EMISSIONS TRENDS (CO_2)
(Sheet 1 of 5)

Portugal
2004
Submission 2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)															
1. Energy	**0,00**	**39.087,12**	**40.880,94**	**45.215,88**	**43.789,12**	**44.346,80**	**47.704,17**	**45.098,15**	**47.712,76**	**51.985,83**	**59.149,44**	**57.657,40**	**58.566,31**	**62.417,89**	**57.909,60**	**58.962,77**
A. Fuel Combustion (Sectoral Approach)	0,00	38.963,28	40.755,56	45.069,94	43.625,86	43.949,05	47.170,52	44.616,62	47.118,70	51.405,79	58.596,55	57.116,75	57.866,79	61.679,46	57.071,96	58.129,44
1. Energy Industries		15.944,40	16.608,95	19.662,45	17.636,27	16.772,23	19.303,14	15.448,00	16.170,88	18.666,36	24.601,66	20.763,43	21.348,87	24.688,75	20.329,78	21.256,14
2. Manufacturing Industries and Construction		9.157,88	9.398,28	9.605,72	9.599,62	9.937,96	10.128,83	10.420,55	11.432,66	11.287,17	11.253,92	11.741,83	11.288,23	11.063,21	10.736,00	10.667,99
3. Transport		9.827,75	10.494,70	11.381,20	11.816,52	12.418,71	13.057,58	13.705,68	14.479,96	16.236,98	17.062,59	18.771,13	19.066,10	19.552,97	19.436,15	19.373,55
4. Other Sectors		4.025,13	4.247,80	4.415,00	4.570,51	4.819,67	4.680,97	5.042,39	5.035,20	5.215,28	5.678,38	5.840,36	6.163,59	6.374,53	6.570,02	6.831,76
5. Other		8,13	5,83	5,57	2,94	0,48	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Fugitive Emissions from Fuels	0,00	123,83	125,38	145,95	163,26	397,75	533,65	481,53	594,06	580,04	552,88	540,64	699,52	738,43	837,64	833,34
1. Solid Fuels		8,65	8,37	7,80	7,25	5,41	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2. Oil and Natural Gas		115,19	117,01	138,15	156,01	392,34	533,65	481,53	594,06	580,04	552,88	540,64	699,52	738,43	837,64	833,34
2. Industrial Processes	**0,00**	**4.048,66**	**4.055,78**	**3.856,98**	**3.890,46**	**4.528,01**	**5.160,60**	**4.873,47**	**5.532,30**	**5.948,03**	**5.315,81**	**5.451,47**	**5.780,74**	**6.136,40**	**5.984,92**	**6.058,47**
A. Mineral Products		3.384,40	3.514,14	3.420,30	3.499,12	3.636,16	3.841,96	3.775,46	3.974,15	4.007,31	4.320,73	4.358,71	4.199,23	4.471,63	4.219,12	4.182,47
B. Chemical Industry		634,38	510,28	399,38	351,29	850,59	1.278,37	1.058,09	1.511,64	1.894,06	945,68	1.040,21	1.542,77	1.640,99	1.739,22	1.837,44
C. Metal Production		29,44	30,92	36,86	39,62	40,82	39,84	39,48	46,08	46,23	48,97	52,12	38,30	23,35	26,15	38,12
D. Other Production		0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44
E. Production of Halocarbons and SF_6																
F. Consumption of Halocarbons and SF_6																
G. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
3. Solvent and Other Product Use		**219,71**	**234,45**	**242,65**	**235,58**	**253,31**	**256,27**	**274,69**	**284,67**	**289,82**	**284,80**	**290,02**	**303,81**	**311,62**	**317,93**	**320,15**
4. Agriculture	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Enteric Fermentation		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Manure Management		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
C. Rice Cultivation		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
D. Agricultural Soils [2]		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
E. Prescribed Burning of Savannas		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
F. Field Burning of Agricultural Residues		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
G. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
5. Land-Use Change and Forestry [3]	**0,00**	**3.060,10**	**1.897,42**	**-187,80**	**-754,36**	**-1.877,98**	**-2.389,78**	**-3.757,28**	**-3.964,87**	**-4.615,43**	**-4.075,61**	**-4.547,93**	**-4.315,34**	**-4.888,80**	**6.984,74**	**-3.194,84**
A. Changes in Forest and Other Woody Biomass Stocks		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Forest and Grassland Conversion		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
C. Abandonment of Managed Lands		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
D. CO_2 Emissions and Removals from Soil		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
E. Other		736,54	1.006,26	350,46	183,63	114,17	719,70	255,56	98,15	466,93	264,41	575,97	380,31	546,72	2.400,09	476,01
6. Waste	**0,00**	**10,10**	**10,11**	**10,11**	**10,11**	**10,11**	**10,11**	**11,29**	**13,14**	**9,89**	**143,71**	**360,93**	**350,10**	**358,76**	**350,01**	**330,12**
A. Solid Waste Disposal on Land		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Waste-water Handling		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
C. Waste Incineration		10,08	10,08	10,08	10,08	10,08	10,08	11,26	13,11	9,86	143,68	360,93	350,10	358,76	350,01	330,12
D. Other		0,02	0,02	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,00	0,00	0,00	0,00	0,00
7. Other *(please specify)* [redacted]	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
Total Emissions/Removals with LUCF [4]	**0,00**	**46.425,70**	**47.078,70**	**49.137,83**	**47.170,91**	**47.260,25**	**50.741,37**	**46.500,31**	**49.577,99**	**53.618,15**	**60.818,14**	**59.211,88**	**60.685,62**	**64.335,88**	**71.547,19**	**62.476,68**
Total Emissions without LUCF [4]	**0,00**	**43.365,60**	**45.181,28**	**49.325,62**	**47.925,27**	**49.138,23**	**53.131,16**	**50.257,59**	**53.542,86**	**58.233,58**	**64.893,75**	**63.759,81**	**65.000,96**	**69.224,68**	**64.562,45**	**65.671,52**
Memo Items:																
International Bunkers	**0,00**	**3.170,55**	**3.282,92**	**3.328,66**	**3.245,67**	**3.301,91**	**3.434,76**	**3.620,50**	**3.592,60**	**3.682,35**	**3.715,43**	**4.011,01**	**3.789,62**	**3.843,40**	**3.896,27**	**4.213,72**
Aviation		1.390,67	1.448,57	1.447,73	1.327,36	1.372,06	1.500,66	1.648,35	1.678,92	1.826,33	1.847,27	2.131,66	1.989,36	2.002,52	2.094,18	2.374,25
Marine		1.779,89	1.834,35	1.880,93	1.918,30	1.929,86	1.934,10	1.972,15	1.913,69	1.856,02	1.868,17	1.879,36	1.800,26	1.840,88	1.802,09	1.839,48
Multilateral Operations		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass		**10.570,89**	**10.650,41**	**10.593,73**	**10.451,33**	**10.163,45**	**10.295,44**	**10.379,60**	**10.667,71**	**10.613,97**	**10.780,08**	**10.747,65**	**10.684,43**	**10.734,26**	**10.368,21**	**11.534,64**

[1] Fill in the base year adopted by the Party under the Convention, if different from 1990.
[2] See footnote 4 to Summary 1.A of this common reporting format.
[3] Take the net emissions as reported in Summary 1.A of this common reporting format. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).
[4] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report CO_2 emissions and removals from Land-Use Change and Forestry.

Source: IAb, 2006

Table 44. Emission trends (CH_4) (2006 submission)

TABLE 10 EMISSIONS TRENDS (CH_4)
(Sheet 2 of 5)

Portugal
2004
Submission 2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)															
Total Emissions	**0,00**	**541,89**	**558,78**	**550,42**	**551,47**	**575,71**	**596,38**	**596,93**	**605,85**	**633,31**	**643,55**	**593,53**	**587,49**	**603,34**	**624,41**	**589,16**
1. Energy	**0,00**	**26,90**	**26,33**	**26,40**	**26,06**	**25,88**	**24,14**	**24,13**	**26,13**	**29,10**	**31,03**	**30,30**	**44,92**	**49,34**	**54,00**	**41,15**
A. Fuel Combustion (Sectoral Approach)	0,00	22,08	21,76	21,76	21,70	21,75	22,08	22,25	22,12	21,79	21,54	21,36	21,14	21,24	21,25	21,36
1. Energy Industries		0,21	0,21	0,24	0,22	0,23	0,25	0,22	0,23	0,25	0,29	0,26	0,27	0,31	0,28	0,32
2. Manufacturing Industries and Construction		1,81	1,93	2,06	2,06	2,07	2,21	2,23	2,40	2,41	2,56	2,57	2,59	2,69	2,63	2,71
3. Transport		3,47	3,74	4,10	4,39	4,57	4,74	4,86	4,50	4,29	4,02	3,92	3,58	3,54	3,38	3,24
4. Other Sectors		16,59	15,87	15,35	15,03	14,88	14,88	14,94	14,98	14,84	14,67	14,61	14,70	14,71	14,96	15,08
5. Other		0,01	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Fugitive Emissions from Fuels	0,00	4,82	4,58	4,64	4,37	4,12	2,06	1,88	4,01	7,31	9,49	8,94	23,78	28,10	32,75	19,79
1. Solid Fuels		3,14	3,04	2,84	2,64	1,97	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2. Oil and Natural Gas		1,68	1,53	1,80	1,73	2,16	2,06	1,88	4,01	7,31	9,49	8,94	23,78	28,10	32,75	19,79
2. Industrial Processes	**0,00**	**0,43**	**0,39**	**0,43**	**0,43**	**0,44**	**0,46**	**0,43**	**0,50**	**0,57**	**0,54**	**0,54**	**0,57**	**0,58**	**0,60**	**0,62**
A. Mineral Products		0,04	0,05	0,06	0,06	0,06	0,07	0,05	0,09	0,09	0,06	0,06	0,08	0,08	0,08	0,09
B. Chemical Industry		0,40	0,34	0,37	0,38	0,38	0,39	0,38	0,41	0,48	0,47	0,48	0,49	0,50	0,52	0,53
C. Metal Production		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
D. Other Production		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
E. Production of Halocarbons and SF_6																
F. Consumption of Halocarbons and SF_6																
G. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
3. Solvent and Other Product Use		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
4. Agriculture	**0,00**	**193,89**	**197,84**	**191,77**	**184,84**	**194,77**	**199,21**	**202,37**	**197,58**	**201,82**	**205,89**	**207,56**	**207,31**	**207,20**	**203,71**	**208,58**
A. Enteric Fermentation		124,85	126,57	124,95	120,51	127,13	133,13	135,98	131,41	136,13	140,47	142,66	141,84	141,62	138,67	143,44
B. Manure Management		56,02	58,36	58,40	58,79	58,18	57,49	55,42	55,12	55,20	55,54	55,54	55,73	55,73	55,03	55,12
C. Rice Cultivation		12,18	12,05	7,60	4,75	8,66	7,82	10,18	10,27	9,73	9,11	8,59	8,98	9,08	9,24	9,24
D. Agricultural Soils		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
E. Prescribed Burning of Savannas		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
F. Field Burning of Agricultural Residues		0,85	0,86	0,82	0,79	0,80	0,78	0,78	0,78	0,77	0,77	0,76	0,77	0,77	0,78	0,78
G. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
5. Land-Use Change and Forestry	**0,00**	**7,31**	**11,54**	**3,65**	**2,19**	**1,24**	**8,05**	**2,81**	**1,05**	**5,28**	**2,86**	**6,31**	**4,17**	**5,99**	**26,30**	**5,22**
A. Changes in Forest and Other Woody Biomass Stocks		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Forest and Grassland Conversion		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
C. Abandonment of Managed Lands		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
D. CO_2 Emissions and Removals from Soil		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
E. Other		7,31	11,54	3,65	2,19	1,24	8,05	2,81	1,05	5,28	2,86	6,31	4,17	5,99	26,30	5,22
6. Waste	**0,00**	**313,36**	**322,68**	**328,16**	**337,94**	**353,38**	**364,52**	**367,20**	**380,58**	**396,53**	**403,24**	**348,82**	**330,52**	**340,22**	**339,80**	**333,61**
A. Solid Waste Disposal on Land		185,32	193,85	202,60	211,59	220,95	230,54	240,73	251,77	265,12	278,66	228,00	214,20	225,24	225,61	226,47
B. Waste-water Handling		128,03	128,83	125,56	126,36	132,43	133,97	126,46	128,81	131,41	124,57	120,77	116,27	114,93	114,14	107,09
C. Waste Incineration		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,05	0,05	0,05	0,05	0,04
D. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
7. Other *(please specify)*	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Memo Items:																
International Bunkers	**0,00**	**0,08**	**0,07**	**0,07**	**0,07**	**0,07**	**0,08**	**0,08**	**0,08**	**0,09**	**0,08**	**0,09**	**0,08**	**0,08**	**0,08**	**0,08**
Aviation		0,05	0,04	0,04	0,04	0,04	0,05	0,05	0,05	0,06	0,05	0,06	0,05	0,05	0,05	0,05
Marine		0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03
Multilateral Operations		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass																

Source: IAb, 2006

Table 45. Emission trends (N_2O) (2006 submission)

TABLE 10 EMISSIONS TRENDS (N_2O)
(Sheet 3 of 5)

Portugal
2004
Submission 2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)															
Total Emissions	**0,00**	**17,35**	**17,47**	**17,35**	**17,06**	**17,94**	**18,69**	**18,73**	**19,56**	**19,11**	**20,00**	**19,27**	**20,36**	**20,05**	**20,29**	**20,15**
1. Energy	**0,00**	**1,68**	**1,74**	**1,82**	**1,98**	**2,14**	**2,29**	**2,43**	**2,46**	**2,50**	**2,78**	**2,93**	**3,00**	**3,15**	**3,05**	**3,09**
A. Fuel Combustion (Sectoral Approach)	0,00	1,68	1,74	1,82	1,98	2,14	2,29	2,43	2,46	2,50	2,78	2,93	3,00	3,15	3,05	3,09
1. Energy Industries		0,20	0,20	0,23	0,22	0,22	0,25	0,21	0,22	0,25	0,37	0,31	0,31	0,36	0,31	0,35
2. Manufacturing Industries and Construction		0,22	0,22	0,23	0,23	0,23	0,24	0,24	0,26	0,26	0,28	0,29	0,28	0,29	0,29	0,31
3. Transport		0,50	0,53	0,58	0,73	0,89	1,02	1,13	1,25	1,44	1,57	1,75	1,79	1,87	1,87	1,88
4. Other Sectors		0,76	0,78	0,78	0,80	0,80	0,79	0,85	0,73	0,55	0,56	0,59	0,61	0,63	0,57	0,55
5. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1. Solid Fuels		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2. Oil and Natural Gas		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2. Industrial Processes	**0,00**	**1,83**	**1,72**	**1,62**	**1,03**	**1,58**	**1,93**	**2,04**	**2,07**	**1,45**	**2,41**	**1,40**	**1,88**	**1,90**	**1,93**	**1,95**
A. Mineral Products		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Chemical Industry		1,83	1,72	1,62	1,03	1,58	1,93	2,04	2,07	1,45	2,41	1,40	1,88	1,90	1,93	1,95
C. Metal Production		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
D. Other Production		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
E. Production of Halocarbons and SF_6																
F. Consumption of Halocarbons and SF_6																
G. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
3. Solvent and Other Product Use		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
4. Agriculture	**0,00**	**12,28**	**12,38**	**12,35**	**12,47**	**12,57**	**12,77**	**12,61**	**13,36**	**13,36**	**12,96**	**13,00**	**13,53**	**13,03**	**13,18**	**13,11**
A. Enteric Fermentation		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Manure Management		1,82	1,84	1,84	1,88	1,90	1,93	1,94	1,95	1,99	2,01	2,03	1,99	1,95	1,88	1,86
C. Rice Cultivation		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
D. Agricultural Soils		10,40	10,49	10,45	10,53	10,62	10,79	10,62	11,36	11,32	10,90	10,91	11,49	11,02	11,25	11,20
E. Prescribed Burning of Savannas		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
F. Field Burning of Agricultural Residues		0,06	0,06	0,06	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05
G. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
5. Land-Use Change and Forestry	**0,00**	**0,05**	**0,08**	**0,03**	**0,02**	**0,01**	**0,06**	**0,02**	**0,01**	**0,04**	**0,02**	**0,04**	**0,03**	**0,04**	**0,18**	**0,04**
A. Changes in Forest and Other Woody Biomass Stocks		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Forest and Grassland Conversion		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
C. Abandonment of Managed Lands		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
D. CO_2 Emissions and Removals from Soil		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
E. Other		0,05	0,08	0,03	0,02	0,01	0,06	0,02	0,01	0,04	0,02	0,04	0,03	0,04	0,18	0,04
6. Waste	**0,00**	**1,52**	**1,55**	**1,54**	**1,56**	**1,63**	**1,64**	**1,63**	**1,67**	**1,77**	**1,83**	**1,90**	**1,92**	**1,93**	**1,95**	**1,96**
A. Solid Waste Disposal on Land		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Waste-water Handling		1,51	1,54	1,54	1,56	1,63	1,64	1,63	1,66	1,76	1,79	1,80	1,83	1,84	1,86	1,87
C. Waste Incineration		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,04	0,09	0,09	0,09	0,09	0,08
D. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
7. Other *(please specify)*	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Memo Items:																
International Bunkers	**0,00**	**0,09**	**0,09**	**0,09**	**0,09**	**0,09**	**0,09**	**0,10**	**0,10**	**0,10**	**0,10**	**0,11**	**0,10**	**0,10**	**0,11**	**0,12**
Aviation		0,04	0,04	0,04	0,04	0,04	0,04	0,05	0,05	0,05	0,05	0,06	0,06	0,06	0,06	0,07
Marine		0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05
Multilateral Operations		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass																

Source: IAb, 2006

Table 46. Emission trends (HFCs, PFCs and SF_6) (2006 submission)

TABLE 10 EMISSION TRENDS (HFCs, PFCs and SF_6)
(Sheet 4 of 5)

Portugal
2004
Submission 2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)															
Emissions of HFCs[5] - CO_2 equivalent (Gg)	**0,00**	**0,00**	**0,00**	**0,00**	**0,23**	**0,46**	**6,45**	**15,64**	**29,30**	**49,35**	**89,04**	**138,11**	**173,49**	**217,33**	**312,64**	**368,32**
HFC-23		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HFC-32		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HFC-41																
HFC-43-10mee																
HFC-125		0,00	0,00	0,00	0,00	0,00	0,00000	0,00032	0,00086	0,00150	0,00307	0,00565	0,00876	0,01195	0,01702	0,01909
HFC-134																
HFC-134a		0,00	0,00	0,00	0,00	0,00	0,00431	0,00878	0,01538	0,02569	0,04040	0,05674	0,07322	0,09009	0,12206	0,14599
HFC-152a		0,00	0,00	0,00	0,00	0,00	0,00607	0,01349	0,02492	0,04226	0,06324	0,09113	0,11810	0,13504	0,27514	0,29399
HFC-143																
HFC-143a		0,00	0,00	0,00	0,00	0,00	0,00000	0,00038	0,00090	0,00153	0,00325	0,00555	0,00838	0,01121	0,01451	0,01716
HFC-227ea		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HFC-236fa																
HFC-245ca																
Emissions of PFCs[5] - CO_2 equivalent (Gg)	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
CF_4		0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
C_2F_6		0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
C_3F_8																
C_4F_{10}																
c-C_4F_8																
C_5F_{12}																
C_6F_{14}																
Emissions of SF_6[5] - CO_2 equivalent (Gg)	**0,00**	**1,82**	**2,09**	**2,37**	**2,65**	**2,92**	**2,82**	**3,30**	**3,41**	**3,30**	**3,90**	**4,88**	**4,51**	**4,57**	**4,57**	**3,44**
SF_6		0,00	0,00	0,00	0,00	0,00	0,00012	0,00014	0,00014	0,00014	0,00016	0,00020	0,00019	0,00019	0,00019	0,00014

Chemical	GWP
HFCs	
HFC-23	11700
HFC-32	650
HFC-41	150
HFC-43-10mee	1300
HFC-125	2800
HFC-134	1000
HFC-134a	1300
HFC-152a	140
HFC-143	300
HFC-143a	3800
HFC-227ea	2900
HFC-236fa	6300
HFC-245ca	560
PFCs	
CF_4	6500
C_2F_6	9200
C_3F_8	7000
C_4F_{10}	7000
c-C_4F_8	8700
C_5F_{12}	7500
C_6F_{14}	7400
SF_6	23900

[5] Enter information on the actual emissions. Where estimates are only available for the potential emissions, specify this in a comment to the corresponding cell. Only in this row the emissions are expressed as CO_2 equivalent emissions in order to facilitate data flow among spreadsheets.

Source: IAb, 2006

Table 47. Emission trends, by sector and by gas, 1990-2004 (2006 submission)

TABLE 10 EMISSION TRENDS (SUMMARY)
(Sheet 5 of 5)

Portugal
2004
Submission 2006

GREENHOUSE GAS EMISSIONS	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	CO_2 equivalent (Gg)															
Net CO_2 emissions/removals	0,00	46.425,70	47.078,70	49.137,83	47.170,91	47.260,25	50.741,37	46.500,31	49.577,99	53.618,15	60.818,14	59.211,88	60.685,62	64.335,88	71.547,19	62.476,68
CO_2 emissions (without LUCF) [6]	0,00	43.365,60	45.181,28	49.325,62	47.925,27	49.138,23	53.131,16	50.257,59	53.542,86	58.233,58	64.893,75	63.759,81	65.000,96	69.224,68	64.562,45	65.671,52
CH_4	0,00	11.379,78	11.734,47	11.558,83	11.580,88	12.089,85	12.523,91	12.535,46	12.722,76	13.299,43	13.514,49	12.464,18	12.337,35	12.670,08	13.112,64	12.372,35
N_2O	0,00	5.378,56	5.416,36	5.379,98	5.287,95	5.559,93	5.793,48	5.807,07	6.063,23	5.922,69	6.199,61	5.973,28	6.312,59	6.216,99	6.289,66	6.245,76
HFCs	0,00	0,00	0,00	0,00	0,23	0,46	6,45	15,64	29,30	49,35	89,04	138,11	173,49	217,33	312,64	368,32
PFCs	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
SF_6	0,00	1,82	2,09	2,37	2,65	2,92	2,82	3,30	3,41	3,30	3,90	4,88	4,51	4,57	4,57	3,44
Total (with net CO_2 emissions/removals)	**0,00**	**63.185,86**	**64.231,62**	**66.079,00**	**64.042,62**	**64.913,42**	**69.068,04**	**64.861,78**	**68.396,69**	**72.892,91**	**80.625,18**	**77.792,32**	**79.513,55**	**83.444,85**	**91.266,70**	**81.466,55**
Total (without CO_2 from LUCF) [6]	**0,00**	**60.125,75**	**62.334,20**	**66.266,80**	**64.796,98**	**66.791,39**	**71.457,83**	**68.619,06**	**72.361,56**	**77.508,34**	**84.700,79**	**82.340,25**	**83.828,89**	**88.333,65**	**84.281,97**	**84.661,38**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	CO_2 equivalent (Gg)															
1. Energy	0,00	40.171,90	41.972,56	46.334,36	44.950,00	45.555,13	48.921,27	46.359,53	49.022,87	53.371,46	60.661,90	59.202,28	60.439,03	64.430,40	59.989,36	60.783,79
2. Industrial Processes	0,00	4.626,24	4.600,23	4.370,04	4.222,99	5.029,59	5.779,07	5.533,33	6.216,37	6.461,24	6.167,06	6.040,90	6.553,14	6.960,35	6.911,96	7.047,82
3. Solvent and Other Product Use	0,00	219,71	234,45	242,65	235,58	253,31	256,27	274,69	284,67	289,82	284,80	290,02	303,81	311,62	317,93	320,15
4. Agriculture	0,00	7.877,64	7.993,70	7.856,41	7.746,16	7.986,92	8.141,50	8.158,62	8.291,63	8.379,47	8.342,37	8.387,27	8.548,78	8.390,30	8.363,22	8.445,37
5. Land-Use Change and Forestry [7]	0,00	3.229,28	2.164,30	-103,36	-703,66	-1.849,30	-2.203,58	-3.692,32	-3.940,49	-4.493,37	-4.009,57	-4.401,94	-4.218,94	-4.750,22	7.593,09	-3.074,18
6. Waste	0,00	7.061,08	7.266,38	7.378,91	7.591,54	7.937,76	8.173,50	8.227,95	8.521,64	8.884,29	9.178,62	8.273,79	7.887,73	8.102,41	8.091,14	7.943,60
7. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

[6] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report CO_2 emissions and removals from Land-Use Change and Forestry.
[7] Net emissions.

Source: IAb, 2006

Table 48. Summary report for methods and emission factors used (1 of 2)

SUMMARY 3 SUMMARY REPORT FOR METHODS AND EMISSION FACTORS USED
(Sheet 1 of 2)

Portugal
2004
Submission 200

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Method applied [1]	Emission factor [2]	Method applied [1]	Emission factor [2]	Method applied [1]	Emission factor [2]	Method applied [1]	Emission factor [2]	Method applied [1]	Emission factor [2]	Method applied [1]	Emission factor [2]
1. Energy												
A. Fuel Combustion												
1. Energy Industries	T2	D+C	T2	D+C	T2	D+C						
2. Manufacturing Industries and Construction	T2	D+C	T2	D+C+CS	T2	D+C+CS						
3. Transport	M	D+C	M	D+C+CS	M	D+C+CS						
4. Other Sectors	T2	D+C	T2	D+C	T2	D+C						
5. Other	T2	D+C	T2	D+C	T2	D+C						
B. Fugitive Emissions from Fuels												
1. Solid Fuels	MB	C	T2	D+C	T2							
2. Oil and Natural Gas	MB	C+CS	C+T2	D+C	C+T2							
2. Industrial Processes												
A. Mineral Products	D	D+C+CS	D	D+C	D	D+C						
B. Chemical Industry	MB+D	D+C	D	D+C	D	D+C						
C. Metal Production	D	D+C+CS	D	D+C	D	D+C						
D. Other Production	D	D+C										
E. Production of Halocarbons and SF_6												
F. Consumption of Halocarbons and SF_6							D	D+CS	D	D+CS	D	CS
G. Other												

[1] Use the following notation keys to specify the method applied: D (IPCC default), RA (Reference Approach), T1 (IPCC Tier 1), T1a, T1b, T1c (IPCC Tier 1a, Tier 1b and Tier 1c, respectively), T2 (IPCC Tier 2), T3 (IPCC Tier 3), C (CORINAIR), CS (Country Specific), M (Model). If using more than one method, enumerate the relevant methods. Explanations of any modifications to the default IPCC methods, as well as information on the proper use of methods per source category where more than one method is indicated, and explanations on the country specific methods, should be provided in the documentation box of the relevant Sectoral background data table.

[2] Use the following notation keys to specify the emission factor used: D (IPCC default), C (CORINAIR), CS (Country Specific), PS (Plant Specific), M (Model). Where a mix of emission factors has been used, use different notations in one and the same cells with further explanation in the documentation box of the relevant Sectoral background data table.

MB- Mass Balance

Source: IAb, 2006

Table 49. Summary report for methods and emission factors used (2 of 2)

SUMMARY 3 SUMMARY REPORT FOR METHODS AND EMISSION FACTORS USED
(Sheet 2 of 2)

Portugal
2004
Submission 2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Method applied [1]	Emission factor [2]	Method applied [1]	Emission factor [2]	Method applied [1]	Emission factor [2]	Method applied [1]	Emission factor [2]	Method applied [1]	Emission factor [2]	Method applied [1]	Emission factor [2]
3. Solvent and Other Product Use	MB											
4. Agriculture												
A. Enteric Fermentation			T2	D+CS								
B. Manure Management			T2	D (CS)	T2	D (CS)						
C. Rice Cultivation			D	D (CS)								
D. Agricultural Soils					D	D+CS						
E. Prescribed Burning of Savannas												
F. Field Burning of Agricultural Residues			D	D+C+CS	D	D+C+CS						
G. Other												
5. Land-Use Change and Forestry												
A. Changes in Forest and Other Woody Biomass Stocks	D+CS	D+CS										
B. Forest and Grassland Conversion	D+CS	D+CS										
C. Abandonment of Managed Lands	D+CS	D+CS										
D. CO_2 Emissions and Removals from Soil	D+CS	D+CS										
E. Other	D	D	D	D	D	D						
6. Waste												
A. Solid Waste Disposal on Land	T2	D+CS	T2	D+CS								
B. Wastewater Handling			D	D+CS	D	D						
C. Waste Incineration	D	D+C	D	D+C	D	D+C						
D. Other												
7. Other *(please specify)*												

Source: IAb, 2006

Table 50. Key categories of emissions and removals by gas

Key Categories of Emissions and removals by Gas	Activity	Gas	Tier 1				Tier 2				2004 emissions/removals (kton CO2 eq.)
			without LULUCF		with LULUCF		without LULUCF		with LULUCF		
			Level	Trend	Level	Trend	Level	Trend	Level	Trend	
1A 3 b Road Transportation	All Fuels	CO2	X	X	X	X	X	X	X	X	18708
1A 1a Public Electricity and Heat Production	Solid Fuels	CO2	X	X	X	X	X		X	X	11961
1A 2 f Other	Liquid Fuels	CO2	X	X	X	X	X		X		4118
1A 1a Public Electricity and Heat Production	Gaseous Fuels	CO2	X	X	X	X	X	X	X	X	3776
2 A 1Cement Production	Production Quantities	CO2	X	X	X	X	X	X	X		3538
4 D AGRICULTURAL SOILS	Input to Soils	N2O	X	X	X	X	X	X	X	X	3472
1A 4 a Commercial / Institutional	Liquid Fuels	CO2	X	X	X	X	X	X	X	X	3162
1A 1a Public Electricity and Heat Production	Liquid Fuels	CO2	X	X	X	X	X	X	X	X	3033
4 A ENTERIC FERMENTATION	Population size	CH4	X	X	X	X	X	X	X	X	3012
6 A MUNICIPAL SOLID WASTE DISPOSAL ON	SWDisposal on Land	CH4	X	X	X	X	X	X	X	X	2942
1A 1b Petroleum refining	Liquid Fuels	CO2	X	X	X						2475
1A 2 f Other	Gaseous Fuels	CO2	X	X	X	X		X		X	2036
1A 4 b Residential	Liquid Fuels	CO2	X	X	X	X	X		X		1882
6 A 3 Other	Industrial Waste Disposal o	CH4	X	X	X	X	X	X	X	X	1814
2 B 1Ammonia Production	Production Quantities	CO2	X	X	X	X	X	X	X	X	1716
6 B 1Industrial Wastewater	Wastewater	CH4	X	X	X	X	X	X	X	X	1566
1A 2 c Chemicals	Liquid Fuels	CO2	X	X	X	X					1393
4 B MANURE MANAGEMENT	Animal Excretion	CH4	X	X	X	X	X	X	X	X	1158
1A 4 c Agriculture / Forestry / Fishing	Liquid Fuels	CO2	X	X	X	X	X	X	X	X	1054
5 E2 Settlements	Emissions/Removals	CO2			X	X			X	X	872
1A 2 e Food Processing, Beverages and Tobac	Liquid Fuels	CO2	X	X	X	X					695
6 B 2 Domestic and Commercial wastewater	Wastewater	CH4	X	X	X	X	X	X	X	X	693
2 B 2 Nitric Acid Production	Production Quantities	N2O	X	X	X						605
4 B MANURE MANAGEMENT	Animal Excretion	N2O	X	X	X	X	X	X	X	X	577
1A 2 d Pulp, Paper and Print	Liquid Fuels	CO2	X	X	X	X					576
1A 3 b Road Transportation	All Fuels	N2O	X	X	X	X	X	X	X	X	563
1A 2 f Other	Solid Fuels	CO2	X	X	X	X		X	X	X	539
1B 2 a Oil	Liquid Fuels	CO2	X	X	X	X	X	X	X	X	499
2 A 2 Lime Production	Production Quantities	CO2	X	X	X	X	X	X	X	X	437
1A 3 a ii Domestic	Liquid Fuels	CO2	X		X	X	X	X	X	X	401
1A 2 c Chemicals	Gaseous Fuels	CO2	X	X	X	X					388
1A 4 b Residential	Gaseous Fuels	CO2	X	X	X	X					384
1B 2 b Natural gas	Gaseous Fuels	CH4	X	X	X	X	X	X	X	X	373
6 B 2 Domestic and Commercial wastewater	Wastewater	N2O	X		X						362
1A 2 d Pulp, Paper and Print	Gaseous Fuels	CO2	X	X	X	X					334
1A 4 a Commercial / Institutional	Gaseous Fuels	CO2	X	X	X	X					332
6 C WASTE INCINERATION	Waste Incinerated	CO2	X	X	X	X	X	X	X	X	330
1A 4 b Residential	Biomass	CH4	X		X		X	X	X	X	309
2 F 1Refrigeration and Air Conditioning Equipme	Consumption	HFC		X		X	X	X	X	X	280
1A 2 e Food Processing, Beverages and Tobac	Gaseous Fuels	CO2		X		X					248
1B 2 d Other (Geothermal)	Energy Production	CO2		X		X					244
6 B 1Industrial Wastewater	Wastewater	N2O					X	X	X	X	228
1A 3 d ii National navigation	Liquid Fuels	CO2			X						211
4 C RICE CULTIVATION	Culture Surface	CH4			X		X	X	X	X	194
2 A 7 Other	Production Quantities	CO2					X	X	X	X	171
3 C CHEMICAL PRODUCTS, MANUFACTURE	Chemical manufacture and	CO2					X	X	X	X	141
5 A Forest Land	Emissions/Removals	CH4			X				X		110
5 B Cropland	Emissions/Removals	CO2							X		109
3 A PAINT APPLICATION	Paint application	CO2					X	X	X	X	96
1A 3 c Railways	Liquid Fuels	CO2				X					86
1A 4 c Agriculture / Forestry / Fishing	Liquid Fuels	N2O					X	X	X	X	81
3 D OTHER	Other Use of Chemicals	CO2					X	X	X		80
1A 4 b Residential	Biomass	N2O					X	X	X	X	66
1A 1a Public Electricity and Heat Production	Solid Fuels	N2O					X		X	X	57
2 F 2 Foam Blowing	Consumption	HFC					X	X		X	56
1B 2 b Natural gas	Gaseous Fuels	CO2						X		X	48
1A 1a Public Electricity and Heat Production	Gaseous Fuels	N2O					X	X	X	X	29
1A 2 f Other	Biomass	N2O					X		X		25
1A 2 d Pulp, Paper and Print	Biomass	N2O					X		X		17
1A 2 f Other	Gaseous Fuels	N2O						X		X	15
1A 4 b Residential	Liquid Fuels	N2O					X		X		13
2 A 6 Road Paving with Asphalt	Production Quantities	CO2					X	X	X	X	12
1A 1a Public Electricity and Heat Production	Liquid Fuels	N2O					X	X	X	X	8
1A 2 a Iron and Steel	Solid Fuels	CO2	X		X	X					0
5 A Forest Land	Emissions/Removals	CO2			X	X			X	X	-3935
Sub-total without LULUCF											83608
% of total without LULUCF											98.9
TOTAL EMISSIONS WITHOUT LULUCF											84546
Sub-total with LULUCF											80763
% of total with LULUCF											98.7
TOTAL EMISSIONS WITH LULUCF											81812

Source: IAb, 2006

Annex 2.
National Legal Framework on Climate Change

Table 51. Principal relevant legislation on climate change

Relevant Legislation	Description
Notification 129/94, of 23 March	Public announcement that, on the 21st December 1993, Portugal deposited the United Nations Framework Convention on Climate Change ratification instruments
Council of Ministers Resolution 72/98, of 29 June	Creates the Climate Change Commission, subordinate to the Minister of Environment Changed by the Council of Ministers Resolution 59/2001, of 30 May
Council of Ministers Resolution 59/2001, of 30 May	Approves the strategy on climate change
Law 93/2001, of 20 August	Creates the instruments to prevent climate change and its impacts
Decree 7/2002, of 25 March	Approves the Kyoto Protocol to the United Nations Framework Convention on Climate Change, signed in New York on the 29th April 1998
Council of Ministers Resolution 63/2003, of 28 April	Approves the Portuguese energy policy guidelines
Joint Official Communication 1083/2003, of 13 December (II series), of the Ministries of Finance, Economy, and Cities, Spatial Planning and Environment	Defines a work group, and respective tasks, for the preparation of the National Allocation Plan, subordinate to the Climate Change Commission
Council of Ministers Resolution 119/2004, of 31 July	Approves the National Climate Change Programme (PNAC)
Decree-Law 233/2004, of 14 December (with the changes introduced by the Decree-Law 243-A/2004, of 31 December and Decree-Law 230/2005, of 29 December)	Sets-up the GHG emissions licenses trading system of the European Community, transposing to the Directive 2003/87/EC of the European Parliament and Council to national law
Council of Ministers Resolution 171/2004, of 29 November	Approves the Action Programme for Portugal's reduction of oil dependence
Council of Ministers Resolution 53/2005, of 3 March	Approves the National Allocation Plan (PNALE) for the 2005-2007 period
Council of Ministers Resolution 59/2005, of 8 July	Approves the Monitoring and Evaluation Programme of PNAC (PNACm)
Council of Ministers Resolution 68/2005, of 17 March	Creates the National System for the Estimation of Emissions by Sources and Removals by Sinks of Air Pollutants (SNIERPA)
Council of Ministers Resolution 169/2005, of 24 October	Approves the National Energy Strategy
Council of Ministers Resolution 33/2006, of 24 March	Entrusts the Climate Change Commission as the Designated National Authority for the flexibility mechanisms of the Kyoto Protocol
Decree-Law 71/2006, of 24 March	Creates the Portuguese Carbon Fund
Decree-Law 72/2006, of 24 March	Transposes to national law the Directive 2004/101/CE, of the European Parliament and Council, of 27 October (Linking Directive) and changes the Decree-Law 233/2004, of 14 December

Annex 3.
Underlying Assumptions on National Greenhouse Gas Emissions Projections (2010-2020)

Table 52. Projections parameters - Energy

			Reference Scenario				With Additional Measures Scenario				
			Low		High			Low		High	
	2000	2010	2015	2020	2015	2020	2010	2015	2020	2015	2020
Gross domestic consumption in Petajoule (PJ)											
Coal	159.6	142.5	142.5	95.6	142.5	95.7	142.5	142.5	95.6	142.5	95.7
Oil products (without NEU)	553.3	547.6	547.5	573.9	561.3	600.0	528.7	525.0	540.7	536.7	564.4
Natural gas	89.4	178.9	267.8	355.8	298.9	424.5	178.5	283.1	392.9	311.8	459.0
Renewables	156.1	213.6	224.7	238.5	226.0	241.2	216.1	229.1	238.8	230.5	241.6
Electricity (import balance)	3.4	9.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	0.0
Total (without NEU)	961.7	1091.6	1182.5	1263.8	1228.7	1361.4	1074.9	1179.6	1268.1	1221.5	1360.7
NEU: non energy uses (raw materials. lubricants. asphalt. etc.)											
Total electricity production (PJ)											
Coal	49.3	50.4	50.4	33.5	50.4	33.5	50.4	50.4	33.5	50.4	33.5
Oil products	17.6	12.7	4.0	5.0	4.0	5.0	11.3	4.0	5.0	4.0	5.0
Natural gas	23.3	38.5	75.8	115.4	89.3	145.5	31.6	73.8	122.8	86.5	151.9
Renewables	44.2	84.7	94.5	107.4	94.5	107.4	87.0	98.5	107.4	98.5	107.4
Co-generation	17.4	27.0	32.4	35.1	32.4	35.1	28.8	28.8	28.8	28.8	28.8
Total	151.8	213.4	257.2	296.4	270.6	326.5	209.0	255.5	297.5	268.3	326.6
Energy demand per sector and per fuel (delivered) (PJ)											
Energy industries											
Generation of electricity and heat											
Coal	134.2	139.6	139.6	92.8	139.6	92.8	139.6	139.6	92.8	139.6	92.8
Oil Product (without NEU)	98.3	59.4	35.9	37.6	36.0	37.7	46.7	26.6	28.0	26.7	28.0
Natural gas	50.3	104.0	177.1	252.3	203.4	310.0	100.3	183.7	274.7	207.7	329.8
Renewables	84.4	126.1	136.1	149.0	136.1	149.1	128.4	140.1	149.0	140.2	149.1
Other	4.7	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Total	372.0	430.5	490.2	533.1	516.5	591.0	416.4	491.5	545.9	515.6	601.1

			Reference Scenario				With Additional Measures Scenario				
			Low		High			Low		High	
	2000	2010	2015	2020	2015	2020	2010	2015	2020	2015	2020
Refining											
Oil Products (without NEU)	21.6	24.8	26.2	24.0	26.2	24.0	24.8	26.2	24.0	26.2	24.0
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electricity	1.7	2.0	2.0	1.9	2.0	1.9	2.0	2.0	1.9	2.0	1.9
Heat	10.3	12.2	12.4	11.3	12.4	11.3	12.2	12.4	11.3	12.4	11.3
Total	33.6	39.0	40.6	37.2	40.6	37.2	39.0	40.6	37.2	40.6	37.2
Other energy industries											
Oil Products (without NEU)	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Electricity	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heat	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	2.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Industry and Construction and Public Works											
Coal	21.1	2.9	2.9	2.8	2.9	2.9	2.9	2.9	2.8	2.9	2.9
Oil products (without NEU)	65.6	66.1	64.4	63.6	68.1	69.8	64.4	64.0	63.2	65.9	67.3
Natural Gas	28.9	52.5	64.0	73.2	67.9	82.1	53.6	65.4	74.8	69.3	83.6
Renewables	20.7	21.7	21.0	20.2	22.1	22.5	22.0	21.3	20.6	22.4	22.9
Electricity	53.6	65.8	70.7	74.2	74.4	82.2	65.7	71.0	74.5	74.2	82.1
Heat	42.1	47.5	52.8	56.4	54.4	60.9	47.5	52.9	56.5	54.4	60.9
Other	14.9	11.1	10.8	10.3	11.4	11.5	11.1	10.8	10.3	11.4	11.5
Total	246.8	267.7	286.5	300.9	301.2	331.9	267.3	288.2	302.8	300.5	331.2
Residential											
Oil Products (without NEU)	35.0	28.5	26.4	25.0	27.2	26.0	28.2	25.8	24.0	26.5	25.0
Natural gas	4.4	12.6	14.1	14.5	14.0	14.4	12.6	14.1	14.6	14.1	14.5
Renewables	47.6	48.4	48.7	48.9	48.7	48.9	48.4	48.8	49.0	48.8	48.9
Electricity	36.5	58.1	68.2	79.3	70.8	83.9	58.2	68.6	79.8	71.1	84.5
Total	123.4	147.5	157.5	167.7	160.6	173.2	147.4	157.3	167.4	160.5	172.9

			Reference Scenario				With Additional Measures Scenario				
			Low		High			Low		High	
	2000	2010	2015	2020	2015	2020	2010	2015	2020	2015	2020
Services											
Oil Products (without NEU)	29.3	52.7	57.0	62.1	60.8	70.6	49.3	45.6	41.2	49.4	49.7
Natural gas	3.1	8.4	10.5	13.1	11.2	14.9	10.5	17.6	25.9	18.4	27.7
Renewables	0.4	0.7	0.9	1.2	0.9	1.2	0.7	0.9	1.2	0.9	1.2
Electricity	42.7	70.0	86.6	107.0	92.3	121.4	70.9	89.5	112.5	95.3	126.9
Heat	0.1	0.3	0.3	0.4	0.4	0.5	0.3	0.3	0.4	0.4	0.5
Total	75.5	132.1	155.4	183.8	165.7	208.6	131.7	154.0	181.2	164.3	206.0
Agriculture, Forestry and Fisheries											
Oil Products (without NEU)	16.5	10.3	11.1	12.0	11.4	12.3	10.3	11.1	12.0	11.4	12.3
Natural gas	0.0	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2
Electricity	2.5	3.0	3.4	3.7	3.6	4.0	3.0	3.4	3.7	3.6	4.0
Heat	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.4
Total	19.3	13.7	14.9	16.2	15.4	16.9	13.7	14.9	16.2	15.4	16.9
Assumptions on weather parameters, in particular the degrees of heating or cooling / day											
Degrees.day (North zone)	1785	1785	1785	1785	1785	1785	1785	1785	1785	1785	1785
Degrees.day (South zone)	1270	1270	1270	1270	1270	1270	1270	1270	1270	1270	1270

Obs.: the North zone includes the North and Centre regions and the South zone includes Lisbon, Alentejo, Algarve and the Autonomous Regions.

Source: IAa, 2006

Table 53. Projections parameters - Industry

			Reference Scenario				With Additional Measures Scenario				
			Low		High			Low		High	
	2000	2010	2015	2020	2015	2020	2010	2015	2020	2015	2020
Share of industrial sector on GDP and growth rate											
Industrial Sector – GVA (M EUR 2000)	26 779	27 676	30 632	32 840	32 642	37 730	27 676	30 632	32 840	32 642	37 730
Share of industrial sector on GDP (%)	21.9	19.6	18.8	17.7	18.8	17.8	19.6	18.8	17.7	18.8	17.8
		2005-10	2010-15	2015-20	2010-15	2015-20	2005-10	2010-15	2015-20	2010-15	2015-20
Average annual growth rate of the industrial sector		2.00	2.05	1.40	3.36	2.94	2.00	2.05	1.40	3.36	2.94
Obs.: Includes the Construction and Public Works sector											
Production index for the industrial sector	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
(breakdown suggested: industry with intensive energy consumption based on production, in quantities, and Processing industry based on monetary values)											
Obs.											

Source: IAa, 2006

Table 54. Projections parameters – Residential and services

			Reference Scenario				With Additional Measures Scenario				
			Low		Hight			Low		Hight	
	2000	2010	2015	2020	2015	2020	2010	2015	2020	2015	2020
Private consumption level (excluding private transport)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Obs.											
Share of tertiary sector on GDP and growth rate											
Tertiary Sector - GVA (M EUR 2000)	73136	88724	103858	119816	111176	136617	88724	103858	119816	111176	136617
Weight of tertiary sector on GDP (%)	59.8	63.0	63.9	64.7	64.0	64.5	63.0	63.9	64.7	64.0	64.5
		2005-10	2010-15	2015-20	2010-15	2015-20	2005-10	2010-15	2015-20	2010-15	2015-20
Average annual growth rate of the tertiary sector		2.5	3.2	2.9	4.6	4.2	2.5	3.2	2.9	4.6	4.2
Obs.											
		2005-10	2010-15	2015-20	2010-15	2015-20	2005-10	2010-15	2015-20	2010-15	2015-20
Variation rate of floor space for buildings destined for the tertiary sector and housing											
Average annual variation rate of floor space for buildings destined for the tertiary sector		3.3	3.6	4.0	4.4	5.4	3.3	3.6	4.0	4.4	5.4
Average annual growth rate of floor space for buildings destined for housing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Obs.											
Number of housing units and number of workers in the tertiary sector											
Number of workers in the tertiary sector (millions)	2.65	3.00	3.09	3.19	3.17	3.36	3.00	3.09	3.19	3.17	3.36
Number of housing units (millions)	3.53	3.95	4.13	4.30	4.13	4.30	3.95	4.13	4.30	4.13	4.30
Obs.											
	2000	2010	2015	2020	2015	2020	2010	2015	2020	2015	2020
Share of the tertiary and housing sectors on GDP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Obs.											
Energy intensity trend in the tertiary sector (2000 = 100)	100	143	144	148	144	147	143	143	146	142	145
Obs.											
Number of households (millions)	3.53	3.95	4.13	4.30	4.13	4.30	3.95	4.13	4.30	4.13	4.30
Obs.											
		2005-10	2010-15	2015-20	2010-15	2015-20	2005-10	2010-15	2015-20	2010-15	2015-20
Number of new buildings for housing (millions)	0.482	0.283	0.227	0.195	0.227	0.195	0.283	0.227	0.195	0.227	0.195
Obs.											
Energy efficiency improvement rate (2000 = 100)											
Energy intensity (kgep/hab.)	287.4	328.1	346.0	365.2	352.9	377.3	328.0	345.7	364.6	352.6	376.7
Index - Base 2000 = 100	100	114	120	127	123	131	114	120	127	123	131

Source: IAa, 2006

Table 55. Projections parameters – Transport

			Reference Scenario			With Additional Measures Scenario	
				Low	Hight	Low	Hight
	2000	2005	2010	2015	2020	2015	2020
Relationship between transport growth and GDP	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Obs.							
Growth of passenger transport (in passenger.km x 10^6)	94 304	103 782	120 018	134 868	146 265	134 868	146 265
Obs. Only data relative to land and water transport							
Growth of Freight transport i(n tons.km x 10^6)	17 328	22 552	25 980	29 412	32 533	31 028	35 805
Obs. Relative to international traffic, accounting for traffic in national territory only. Data for rail and road transport only.	2 019	2 874	3 318	3 756	4 154	3 962	4 572
Road + Railway (in the national territory)	19 347	25 426	29 298	33 168	36 687	34 990	40 377

Source: IAa, 2006

Table 56. Projections parameters - Agriculture

				Reference Scenario	
				Low	Hight
	2000	2005	2010	2015	2020
Share of agriculture sector on GVA and relative growth	0	0	0	0	0
Obs. The variable GVA was used, because the GDP variable was not discriminated for the agriculture sector. Either way, the relative weight of the agriculture sector on GVA and GDP is very similar. The values for 2004 were adopted, as the values for 2005 are not yet available. For 2010, 2015 and 2020, a trend line was applied based in the 2000-2004 statistical series (forecast function of excel).					
Livestock count by animal type (1000 individuals)					
Dairy cows	350	338	322	296	271
Other bovines	1 063	1 105	1 162	1 119	1 076
Sheep	2 403	2 275	2 237	2 289	2 340
Other ovines	1 138	1 221	1 236	1 265	1 294
Goats	441	417	410	410	410
Other caprines	164	175	178	178	178
Reproductive Swine	324	314	299	299	299
Other swine	2 035	2 034	1 926	1 927	1 928
Horses	40	57	61	61	61
Mules and asses	45	44	32	32	32
Rabitts	338	325	311	288	264
Chickens and roosters	26 770	19 252	19 643	19 416	19 190
Laying and reproductive chickens	12 392	11 535	11 802	10 020	8 238
Turkeys	1 263	1 166	1 068	1 056	1 043
Ducks, geese and guinea-fowl	771	787	804	795	785

			Reference Scenario		
				Low	Hight
	2000	2005	2010	2015	2020
Cultivation surface per type of culture					
Vineyard	217 136	220 286	220 286	220 286	220 286
Fresh Fruit	75 361	76 445	82 570	85 632	88 694
Dry Fruit	71 469	72 352	73 448	73 997	74 545
Olive grove	369 162	374 474	404 474	419 474	434 474
Wheat	226 183	152 190	101 967	76 856	51 745
Corn	152 134	105 695	95 125	89 841	84 556
Triticale	23 832	16 628	11 926	9 575	7 224
Rice	23 859	20 534	23 724	25 319	26 914
Oats	85 034	61 898	58 852	57 330	55 807
Barley	21 755	19 475	19 475	19 475	19 475
Potato	54 145	41 273	41 273	41 273	41 273
Tomato	12 934	12 925	12 925	12 925	12 925
Hop	42	24	0	0	0
Tobacco	2 042	2 298	0	0	0
Synthetic fertilizers					
Nitrogen applied in synthetic fertilizers (t)	148 944	150 000	150 000	150 000	150 000
Emission factors for enteric fermentation (kgCH4/ind.year)					
Dairy cows	113	113	113	113	113
Other bovine	58	58	58	58	58
Sheep	10	10	10	10	10
Goats	8	8	8	8	8
Horses	18	18	18	18	18
Mules and asses	10	10	10	10	10
Swine	1	1	1	1	1
Rabbits	4	4	4	4	4
Emission factors for manure management (kgCH4/ind.year)					
Dairy cows	3	3	3	3	3
Other bovine	2	2	2	2	2
Ovine	0	0	0	0	0
Caprine	0	0	0	0	0
Swine	46	46	46	46	46
Other swine	23	23	23	23	23
Horses	3	3	3	3	3
Mules and asses	3	3	3	3	3
Rabbits	0	0	0	0	0
Chickens and roosters	0	0	0	0	0
Laying and reproductive chickens	0	0	0	0	0
Turkeys	0	0	0	0	0
Ducks, geese and guinea-fowl	0	0	0	0	0

Source: IAa, 2006

Table 57. Parameters for the projection - Forestry

				Reference Scenario	
	2000	2005	2010	Low 2015	Hight 2020
Areas (1 000 ha) of:					
- managed forests	1 115	1 136	1 164	1 185	1 206
- non-managed forests	2 183	2 224	2 280	2 320	2 361
- total forest	3 298	3 360	3 444	3 505	3 567
Obs. **1) The data on forestry pertain to mainland Portugal. Data on the autonomous regions of Azores and Madeira is unavailable due to the absence of inventory data.** **2) The porportion of utilised managed forest (22.8%) was not included in the DGRF annual report titled "Criteria and Indicators of Sustainable Forestry Development", prepared in the context of the Ministerial Conference on the Protection of Forests in Europe (MCPFE).**					
Definitions of forestry surfaces	Areas occupied with forest trees with a minimum cover of at least 10%, occupying an area of at least 0.5 ha and a width not inferior to 20 metres. Includes: • the young settlements and plantations, which density, in the future, will be of at least 10% of cover, and height greater than 5 metres. • the seed orchards and the tree nurseries. • the wind-breakers and hedges, as long as they respect established forestry criteria. • forestry land previously occupied by settlements that, due to a forest fire are now occupied by burnt vegetation or naked land, with a significant presence of dead or carbonized material. • forestry land previously occupied by settlements that were cut down and are now occupied by stumps and insignificant ground vegetation. • other forested areas: forestry land that, in maturity, does not reach a height above 5 metres.				

Source: IAa, 2006

Table 58. Sectoral Scenarios (GVA, average annual growth rates, %)

	Average annual growth rates (%)					
	Scenario 2000-2010		High Scenario 2010-2020		Low Scenario 2010-2020	
	2000-05	2005-10	2010-15	2015-20	2010-15	2015-20
Agriculture	-2.4	-1.6	3.0	2.5	2.0	2.0
Energy	3.6	3.3	4.0	4.0	2.0	2.0
Industry	-0.2	1.8	3.2	2.8	2.0	1.3
Construction	-4.0	2.6	3.7	3.3	2.1	1.6
Services	1.4	2.5	4.6	4.2	3.2	2.9
National GVA	**0.7**	**2.3**	**4.3**	**3.9**	**2.9**	**2.5**
INDUSTRY – SUB-SECTORS						
Extractive Industries	-0.6	2.9	3.4	2.5	2.2	1.7
Food	0.6	2.7	2.5	1.9	2.0	1.0
Drinks	0.6	2.2	3.0	2.4	1.5	0.5
Tobacco	0.6	1.3	2.0	1.5	1.5	1.0
Textile, Clothes, Shoes and Leather	-2.0	-1.3	2.2	1.7	0.3	-0.2
Wood. Cork and Furniture	0.8	2.4	2.2	1.7	1.7	0.7
Paste, Paper and Graphic Arts	0.4	3.7	4.0	3.5	3.0	2.0
Chemicals, Rubber and Plastics	-1.1	2.7	3.5	3.0	2.0	1.5
Ceramics and other non-metallic minerals	-1.9	3.1	3.6	2.7	2.3	1.7
Glass	-1.9	2.7	3.5	3.0	2.0	1.5
Cement and other Construction Materials	-1.9	2.7	3.5	3.0	2.0	1.0
Siderurgy	1.8	2.5	1.5	1.0	0.0	-1.0
Metallurgy	1.8	2.5	1.5	1.0	0.0	-1.0
Metalomechanics and Other Processing Industries	0.5	2.3	4.1	3.6	3.1	2.1
INDUSTRY TOTAL	**-0.2**	**1.8**	**3.2**	**2.8**	**2.1**	**1.3**

Source: IAa, 2006

Table 59. Evolution of technical coefficients of energy intensity (base 100 in 2000)

	Scenario 2000-2010			High Scenario		Low Scenario	
	2000	2005	2010	2015	2020	2015	2020
Extractive Industries – fuel	1.0	1.159	1.154	1.149	1.144	1.152	1.149
Extractive Industries – other	1.0	1.051	1.105	1.133	1.144	1.118	1.124
Extractive Industries – electricity	1.0	1.104	1.189	1.177	1.164	1.183	1.177
Metallurgy – steam, oven	1.0	1.217	1.158	1.102	1.045	1.130	1.102
Metallurgy – electricity	1.0	0.923	0.910	0.885	0.860	0.898	0.885
Chemical – steam, oven, fuel, other	1.0	0.997	0.959	0.921	0.896	0.941	0.928
Chemical – electricity	1.0	1.159	1.218	1.193	1.181	1.206	1.200
Textile – electricity	1.0	0.896	0.871	0.845	0.820	0.858	0.846
Textile – steam	1.0	1.159	1.134	1.109	1.084	1.121	1.109
Paste and Paper – steam	1.0	0.975	0.924	0.873	0.822	0.898	0.873
Paste and Paper – electricity	1.0	1.104	1.160	1.109	1.058	1.135	1.110
Wood – steam	1.0	1.159	1.134	1.109	1.084	1.121	1.109
Wood – electricity	1.0	0.754	0.729	0.721	0.716	0.725	0.722
Cement – oven	1.0	1.051	1.051	1.051	1.051	1.051	1.051
Cement – electricity	1.0	0.949	0.924	0.904	0.883	0.914	0.904
Ceramics / Glass – oven	1.0	1.025	1.013	1.000	0.988	1.006	1.000
Ceramics / Glass – steam	1.0	1.025	1.051	1.078	1.105	1.064	1.078
Ceramics – electricity	1.0	1.000	1.000	0.987	0.975	03994	0.987
Glass – electricity	1.0	1.000	1.00	0.975	0.955	0.987	0.977
Food – steam, oven	1.0	1.077	1.052	1.027	1.002	1.039	1.027
Food – electricity	1.0	1.051	1.078	1.065	1.052	1.071	1.065
Remaining – steam	1.0	0.975	0.949	0.924	0.899	0.937	0.924
Reamaining – electricity	1.0	1.217	1.279	1.228	1.202	1.253	1.241
All sectors – fuel	1.0	0.949	0.898	0.857	0.817	0.878	0.858
Iron-foundry – oven	1.0	1.000	1.000	0.980	0.965	0.990	0.982
Iron-foundry – steam	1.0	0.846	0.834	0.829	0.824	0.831	0.829
Iron-foundry – electricity	1.0	1.000	1.000	1.000	1.000	1.000	1.000
COP – fuel	1.0	1.000	1.000	0.987	0.975	0.994	0.987
COP – electricity	1.0	1.000	1.000	0.987	0.975	0.994	0.987
Agriculture – other	1.0	1.051	1.026	1.001	0.975	1.013	1.001
Agriculture – fuel	1.0	0.783	0.753	0.723	0.692	0.738	0.723
Agriculture – electricity	1.0	1.338	1.478	1.496	1.496	1.487	1.487

Source: IAa, 2006

Table 60. Activity in land passenger transport

	Units	2005	2010	2020 Low Scenario	2020 High Scenario
Inhabitants	10^3 hab.	10 430	10 597	10 824	10 824
Car stock – Passenger Car (PAssCar)	10^3 veic.	4 312	4 895	5 311	5 343
Car stock – Light Duty Vehicles (LDV)	10^3 veic.	620	674	816	861
Total level of mobility[113]	10^9 pkm	104	120	146	146
Modal distribution of TC	% (pkm/pkm)	14.9%	13.7%	14.2%	11.5%
Occupancy levels – PassCar + LDV	pkm/vkm	1.58	1.60	1.62	1.62
Occupancy levels – Motorcycle	pkm/vkm	1.1	1.1	1.1	1.1
Occupancy levels - Moped	pkm/vkm	1.0	1.0	1.0	1.0
Occupancy levels - BUS	pkm/vkm	14.8	13.5	15.4	11.4
Occupancy levels - Coach	pkm/vkm	17.0	19.2	23.0	19.7

Source: IAa, 2006

Table 61. Consumption and emission factors in land passenger transport

	Units	2005	2010	2020 Low Scenario	2020 High Scenario
Passenger cars – all types of traffic: Motorway, rural, and urban					
Specific consumption gasoline, diesel and LPG	gep/vkm	64	62	60	60
Specific emissions of CO_2e gasoline, diesel e LPG	g/vkm	201	195	190	190
Specific consumption gasoline-powered	gep/vkm	69	68	68	68
Specific emissions of CO_2e gasoline-powered	g/vkm	215	212	212	212
Specific consumption diesel-powered	gep/vkm	59	58	57	57
Specific emissions of CO_2e diesel-powered	g/vkm	188	184	182	182
Specific consumption ´ LPG-powered	gep/vkm	63	62	62	62
Specific emissions of CO_2e LPG-powered	g/vkm	170	197	166	166
Motorcycles+Moped					
Specific consumption	gep/vkm	26	26	26	26
Specific emissions of CO_2e	g/vkm	81	82	83	83
Heavy passenger vehicle (BUS+Coach)					
Specific consumption – BUS	gep/vkm	430	430	431	431
Specific emissions of CO_2e – BUS	g/vkm	1 373	1 378	1 386	1 386

[113] Passenger mobility in light vehicles, light freight vehicles (< 3.5 t) associated to passenger transport (NIR), motorcycle, moped, public road transport, conventional railway transport, subway and water transport.

	Units	2005	2010	2020 Low Scenario	2020 High Scenario
Specific consumption - Coach	gep/vkm	219	219	219	219
Specific emissions of CO_2e – Coach	g/vkm	697	697	697	697
Water					
Specific consumption	gep/pkm	38	40	32	43
Specific emissions of CO_2e	g/pkm	117	123	98	133

Source: IAa, 2006

Table 62. Consumption and emission factors in road freight transport

	Units	2005	2010	2020 Low Scenario	2020 High Scenario
Light Freight Vehicle (LDV)					
Specific consumption	gep/vkm	72	71	71	71
Specific emissions of CO_2e	g/vkm	230	228	227	227
Heavy Freight Vehicle (HDV)					
Specific consumption	gep/vkm	168	168	168	168
Specific emissions of CO_2e	g/vkm	538	538	538	538

Source: IAa, 2006

Table 63. Maritime Transport Activity

	Units	2005	2010	2020 Low Scenario	2020 High Scenario
Distance covered	10^3 nautical miles	1 564	1 564	1 564	1 564

Source: IAa, 2006

Table 64. Air Transport Activity

	Units	2005	2010	2020 Low Scenario	2020 High Scenario
Domestic journeys	LTO[114]	43 896	53 766	69 905	73 614

Source: IAa, 2006

[114] Landing Take-off Cycle

Table 65. Summary of the projections of energy consumption in transport (Reference Scenario)

G gep	1990	2000	2005	2010	2020 Low Scenario	2020 High Scenario
Road (passengers and freight)	3 077	6 000	6 364	6 921	7 891	8 113
Road (passengers)	1 804	3 553	3 739	4 092	4 532	4 611
TI – Individual Transport	1 676	3 351	3 539	3 888	4 324	4 403
Gasoline	1 446	2 154	1 907	1 614	1 264	1 277
Diesel	230	1 175	1 614	2 032	2 787	2 849
LPG	0	22	18	18	23	23
Biodiesel	0	0	0	125	172	176
ETBE	0	0	0	99	78	79
TC – Public Transport	128	202	200	204	208	208
Diesel	128	201	195	186	186	186
Natural gas	0	1	5	7	10	10
Biodiesel	0	0	0	11	11	11
Road (Freight)	1 273	2 447	2 624	2 829	3 359	3 502
Heavy (> 3,5 t.)	549	1 443	1 569	1 692	1 996	2 064
Diesel	549	1 443	1 569	1 595	1 881	1 944
Biodiesel	0	0	0	97	115	119
Light (< 3,5 t.)	724	1 004	1 055	1 136	1 363	1 439
Diesel	724	1 001	1 053	1 069	1 282	1 353
Biodiesel	0	0	0	65	79	83
LPG	0	2	2	2	3	3
Railway (diesel-powered)	75	67	55	66	74	67
Diesel	54	41	25	25	22	22
Electricity	21	25	30	42	52	45
Air (domestic)	57	125	133	158	212	216
Maritime (domestic)	73	62	63	63	63	63
Diesel	25	24	38	38	38	38
Fueloil	48	38	25	25	25	25
River	3	10	12	12	13	13
National total	3 282	6 254	6 615	7 208	8 240	8 459

Source: IAa, 2006

Table 66. Scenario on Management and Treatment of Municipal Solid Waste (MSW) (2004-2020)

Year	MSW Production	Landfill	Organic Recovery	Energy Recovery	Total Recycling
			units: 1000 t		
2004	4 704	2 377	506	980	842
2005	4 770	2 167	620	1 049	933
2006	4 827	1 886	869	1 062	1 011
2007	4 875	1 631	1 073	1 121	1 050
2008	4 914	1 369	1 278	1 179	1 088
2009	4 934	1 197	1 382	1 234	1 123
2010	4 944	1 070	1 483	1 236	1 155
2011	4 939	940	1 580	1 235	1 183
2012	4 929	958	1 577	1 183	1 211
2013	4 909	925	1 571	1 178	1 236
2014	4 880	890	1 562	1 171	1 258
2015	4 841	883	1 549	1 162	1 248
2016	4 793	778	1 629	1 150	1 235
2017	4 735	740	1 610	1 136	1 249
2018	4 669	730	1 587	1 120	1 231
2019	4 594	626	1 654	1 103	1 212
2020	4 511	615	1 624	1 083	1 190

Source: IAa, 2006

Table 67. Overview of organic recovery units

Systems / Groups			Type of facility	Starting Year (forecast)	Installed capacity (t)		
					Start	2009	2016
A	**1**	**Valorminho**	Anaerobic digestion + composting	2008	20 000	20 000	20 000
	2	**Resulima**					
	3	**Braval**					
B	**4**	**Amave**	Composting	1995	58 914	58 914	58 914
C	**5**	**Lipor**	Composting + Green Composting	2005	60 000	60 000	60 000
D	**6**	**Valsousa**	Anaerobic digestion + composting	2008	20 000	20 000	30 000
E	**7**	**Suldouro**	Anaerobic digestion + composting	2009	20 000	20 000	20 000
G	**8**	**RESAT**	Anaerobic digestion + composting	2007	10 000	20 000	20 000
	11	**REBAT**					
	12	**RESIDOURO**					

Systems / Groups			Type of facility	Starting Year (forecast)	Installed capacity (t)		
					Start	2009	2016
H	**10**	**Resíduos do Nordeste**	Anaerobic digestion + composting	2008	5 000	10 000	10 000
I	**15**	**Planalto Beirão**	Anaerobic digestion + composting + green composting	2008	35 000	35 000	35 000
J	**16**	**Águas Zêzere e Coa**	Composting	2007	40 000	40 000	40 000
	17	**Raia Pinhal**					
P	**28**	**Valnor**					
K	**13**	**Valorlis**	Anaerobic digestion + composting + domestic composting	2007	20 000	20 000	30 000
	18	**Resioeste**					
L	**19**	**Resiurb**	Anaerobic digestion + composting	2006	20 000	20 000	30 000
	21	**Resitejo**					
M	**22**	**Amtres**	Anaerobic digestion + composting	2007	125 000	125 000	125 000
N	**23**	**Valorsul***	Anaerobic digestion + composting	2005	60 000	60 000	60 000
O	**24**	**Amarsul**	Anaerobic digestion + composting	2006 (C) e 2008 (DA)	20 000	100 000	100 000
P	**25**	**Amde**	Anaerobic digestion + composting + domestic composting	2006	17 600	32 600	32 600
Q	**29**	**Amalga**					
	26	**Amagra**					
	27	**Amcal**					
R	**30**	**ALGAR**	Anaerobic digestion + composting + green composting	2008	40 000	40 000	50 000

Source: IAa, 2006

Table 68. Biogas Management Scenario

Biogas Management Scenario in Portugal					Observations
Coverage of MSW management systems of USW with biogas recovery/burning					
	1998	**2000**	**2005**	**2010**	Combustion of biogas in MSW disposal areas did not occur before 1998
Landfills	21%	29%	67%	92%	
Dumps	12%	19%	31%	31%	
Note: values expected to remain constant in the 2010-2020 period					
Technical conditioning of biogas capture and recovery/combustion systems					
η capture: 75% η combustion: 97% functioning: 7500 hours/year					It is possible that biogas capture and combustion systems operate 7500 hours/year, with yielding capture and combustion rates of 75% and 97%, respectively.
Effective capacity of biogas recovery/combustion					
	1998	**2000**	**2005**	**2010**	Estimated values based on the coverage of the systems and the technical conditioning of the biogas capture and combustion equipments
Landfills	13%	18%	42%	57%	
Dumps	7%	12%	19%	19%	
Note: values expected to remain constant in the 2010-2020 period					

Source: IAa, 2006

Table 69. Production of Organic Industrial Waste Scenario (2004-2020)

Year	Organic BIW[115] (kt)	Organic HIW[116] (kt)	Total Organic IW (kt)
2002	436	0.782	437
2003	445	0.798	445
2004	454	0.814	454
2005	463	0.830	463
2006	472	0.847	473
2007	481	0.864	482
2008	491	0.880	491
2009	499	0.895	500
2010	504	0.903	504
2011	503	0.903	504
2012	500	0.898	501
2013	500	0.897	501
2014	504	0.905	506
2015	512	0.920	513
2016	522	0.937	523
2017	533	0.956	534
2018	543	0.975	544
2019	554	0.994	555
2020	565	1.014	566

Source: IAa, 2006

[115] Biodegradable industrial waste

[116] Hazardous industrial waste

Table 70. Management and treatment of domestic wastewater indices

Distribution of treatment types	1990	1994	1999	Observations
% of population served with treatment above the preliminary level	18.2%	21.1%	42.0%	
% of population served with Collective Septic Tank (CST)	2.2%	2.3%	5.0%	
% of population served with primary treatment	5.2%	5.2%	9.0%	
% of population whose wastewater is discharged in coastal waters, without treatment	6.5%	6.5%	6.5%	
% of population with individual Septic Tank (ST)	1.5%	8.2%	14.8%	Population served by a private system. According to census data, it is estimated that half have ST or another private treatment system, and the rest have a connection, clandestine or legal, to rainwater drainage systems
% of population whose wastewater is released to inland waterbodies, without treatment	36.8%	40.8%	30.3%	Difference between % with public drainage system - % pop served with treatment – pop served with an emissary, without treatment
% of population without wastewater collection (a situation equivalent to latrines)	37.0%	23.4%	6.4%	Percentage of housing units "without sanitation" according to the census
% of population attended with secondary, tertiary or primary with Imhoff tank treatments	10.8%	13.6%	28.0%	
Biological Discs	1.1%	1.4%	2.0%	For 1990 and 1999, distribution is proportional to the number of equipments according to quoted sources; for 1994 an interpolation was made (adjusted by sensitivity) because the data did not discriminate the secondary and tertiary treatments of most of the facilities.
Activated Sludge (without Anaerobic digestion of sludge)	1.4%	2.0%	4.6%	
Activated Sludge (with Anaerobic digestion of sludge)	1.4%	2.0%	4.6%	
Lagooning (with anaerobic lagoon)	1.7%	1.9%	3.6%	
Lagooning (without anaerobic lagoon)	0.6%	0.6%	1.2%	
Percolation bed	3.6%	4.6%	8.8%	
Primary with Imhoff tank	0.6%	0.3%	0.1%	
Oxidation pit	0.3%	0.4%	1.6%	
Other treatments	0.0%	0.3%	1.6%	
% of population without domestic wastewater treatment and no discharge to the ocean	75.3%	72.4%	51.5%	

Source: IAa, 2006

Table 71. Calculation of of CH_4 emissions parameters

Parameter	Observations	
Organic load per capita (C_{CO}):		
C_{CO} = 21,9 Kg CBO_5/inhab year	National Estimation (Source: NIR, INAG) Calculation of Organic load: CO = Population • C_{CO}	
CH_4 Production potential (B_{0i}):		
B_{0i} = 0,6 t CH_4/t CBO_5	IPCC default value	
Share of organic load removed in the sludge:		
Incorporations of organic load were considered in the	Source: INAG expert judgement	
Solid phase (sludge treatment) of 30% for primary treatment, and of 37% for secondary treatments (biological discs, activated sludge, lagooning without anaerobic lagoon, percolation beds, oxidation pits and other secondary treatments)		
Methane conversion factor (FCM_x):	**Liquid Phase**	**Sludge**
Coastal water discharges (without treatment)	0.00	-
Inland water discharges (without treatment)	0.30	-
Systems equivalent to latrines	0.61	-
Individual, private septic tanks	0.50	-
Collective septic tanks	0.50	-
Primary treatment	0.00	0.00
Secondary/tertiary treatments:		
Biological discs	0.17	0.80
Activated sludge (without Anaerobic digestion)	0.1	0.00
Activated sludge (with Anaerobic digestion)	0.17	0.80
Lagooning (with anaerobic lagoon)	0.20	0.00
Lagooning (without anaerobic lagoon)	0.00	0.00
Poercolation bed (with anaerobic digestion of sludges)	0.17	0.80
Imhoff Tank	0.80	0.00
Oxidation pits	0.00	0.00
Oxidation pits	0.00	0.00
Recovery/burning of methane (R_i):		
It was assumed that the recovery/burning of CH4 was made at the sludge anaerobic digestion systems built after 2000. Given that these system are new, the burning of biogas will occur: i) for heating and maintenance of the digestion process and/or ii) energy recovery. A biogas capture and burning yield of 75% and 97%, respectively, is expected.		

Source: IAa, 2006

Table 72. Industrial production and associated pollution coefficients

Industrial activity	Unit of production	Pollution coefficients	
		Kg CQO/t U	Hab-eq/Kg U
Slaughterhouses	t dead animal weight	27	0.881
Swine slaughterhouses	t dead animal weight	41.9	0.900
Poultry Slaughterhouses	t dead animal weight	12.7	0.269
Processing and production of canned meat	t dead animal weight	30	0.978
Pasteurization and bottling of milk	m^3 of dairy	1.8	0.044
Cheese industry	m^3 of dairy	20.1	0.651
Dairy products industry	m^3 of dairy	10.1	0.347
Canned fruit and horticulture products	t product	27	0.734
Tomato paste	t product	32	0.930
Fruit preserves	t product	77.3	2.216
Canned fish	t product	35	0.856
Olive oil production	t olives	45	0.734
Olive oil refining	t product	1.2	0.044
Production and refining of cooking oils	t product	18.8	0.612
Production of margerine and related products	t product	7.5	0.161
Pressing, pealing, grinding and processing of cereals and leguminous plants	t product	9	0.220
Sugar refining	t raw	4.2	0.093
Production of ferments and yeasts	t product	1080	29.354
Production of pure alcohol	m^3 pure alcohol	1192	16.068
Vinic distilleries	m^3 pure alcohol	217.9	4.628
Wine industry	t compressed grapes	7.5	0.220
Beer production	m^3 beer	9.3	0.215
Non-alcoholic drinks industry	t soft drink	9.6	0.294
Wool cleaning	t gross wool	366	4.354
Wool and mixed products finishing	t of wool	347	4.256
Synthetic fibres finishing	t of fibre	268	7.583
Artificial fibres finishing	t of fibre	52	1.468
Spinning, weaving and finishing of cotton	t of cotton	268	7.583
Leather industry	t gross leather	212.5	4.159
Cork baking	t of cork	8	0.073
Cork industry	m^3 of block	1104	4.061
Production of sulphate paste	t of paste	158.4	1.345
Production of sulphite paste	t of paste	1050	13.845
Production of kraft paper	t of paste	2.8	0.034
Production of fibre panels	t of paste	43.4	0.695
Production of alkali and chlorine	t of ClNa	39	1.336
Production of inorganic acids	t of inorganic acid	50	1.712
Production of cyclical hydrocarbons	t of final product	570	13.943
Production of aliphatic hydrocarbons	t of final product	570	13.943
Production of fertilizers	t of fertiliser	37.5	0.734
Production of pesticides	t of pesticide	30	1.111
Production of condensation and poliadiction & Production of polymerisation and copolymerisation products	t of product	45	0.734
Production of synthetic rubber	t of product	45	0.734
Production of artificial fibres	t of fibre	450	7.339
Production of polyester fibres	t of fibre	16.3	0.313
Production of acrylic fibres	t of fibre	121.1	2.422
Production of paints, varnishes and lacquers	t of final product	9.2	0.029
Production of compounded products, or of vegetal or	1 emp	13.5	0.462

Industrial activity	Unit of production	Pollution coefficients	
		Kg CQO/t U	Hab-eq/Kg U
animal origin for pharmaceutical use			
Production of soap	t of product	12	0.294
Production of synthetic detergents	T of detergent	1.7	0.029
Oil refineries	t of final product	1.5	0.029

Source: IAa, 2006

Table 73. Types of treatment / final destination of Industrial wastewaters and calculation of CH_4 emissions parameters

Parameter	Observations			
Production potential of CH_4 (B_0):				
B_0 = 0.25 t CH_4/t CQO	IPCC default value			
Methane conversion factor (MCF_x):	**1990**	**1995**	**2000**	**2005**
Discharges to inland waterbodies or to the ground (without treatmeant)	0.10			
Primary treatment	0.00			
Secondary treatment (good management)	0.00			
Secondary treatment (bad management)	0.30			
Septic tanks	0.50			
Discharge in municipal system with treatment [a]	0.18	0.18	0.15	0.12
Unknown treatment [b]	0.24	0.23	0.19	0.22
[a] values defined every year: corresponds to the average value of MCF for domestic wastewater treatment systems, weighed by the service indices of each system; [b] values defined every year: corresponds to the average value of MCF for all destinations of domestic wastewater, weighed by the service indeces of each destination;				
Recovery/burning of methane (Ri):				
It is assumed that the same % of methane burning/recovery defined for domestic wastewater treatment applies.				

Source: IAa, 2006

Table 74. Industrial wastewater loads [2005-2020]

	2005		2010		2015		2020	
	t CQO	1000 hab eq	t CQO	1000 hab eq	t CQO	1000 hab eq	t CQO	1000 hab eq
Food and drinks industries	209 207	5 862	239 016	6 698	239 358	7 395	251 567	7 772
Textile industry	56 209	1 494	52 649	1 400	53 443	1 421	52 911	1 407
Wood and wood products industries	1 045 394	6 390	1 177 009	7 194	1 280 515	7 827	1 325 965	8 104
Chemical industry	917 357	21 875	1 048 070	24 991	1 157 154	27 593	1 246 584	29 725
Refining and petrochemicals [117]	57 670	1 007	57 670	1 007	57 670	1 007	57 670	1 007
Total	2 285 836	36 627	2 574 414	41 289	2 788 140	45 241	2 934 697	48 015

Source: IAa, 2006

[117] In the period 1990-2003, the worst situation was assumed (load generation) due to the refining sector´s limited physical processing capacity.

Annex 4.
Research Projects on Climate Change (2000-2004)

Funded by FCT

2000

Title

BLACK CARBON LEVELS IN THE ATMOSPHERE OVER THE NORTH ATLANTIC OCEAN

Proposing Institution

Instituto do Mar - IMAR

Summary

The North Atlantic atmosphere is particularly susceptible to impacts from long-range transport of air pollutants. Two main reasons explain these negative impacts: the emission of large amounts of pollutants from populated and industrialised areas in the eastern coast of North America; and the dominant westerly wind regime in the area bounded by approximately 30 ºN and 60 ºN. Combustion-generated black carbon (BC) particles are a ubiquitous component of the atmospheric aerosol transported into the North Atlantic atmosphere and have been the focus of attention in recent years because of the role they can play in climate change. The chemical inertness of BC particles, coupled with their small sizes, prolong their atmospheric residence time, which is on the order of several days. Such long lifetime indicates that long-range transport becomes important and suggests that BC can serve as a tracer of anthropogenic activity in polluted air masses. It is also known that BC has a high specific absorption of solar radiation. Consequently, there is a strong suspect that aerosol transport from polluted areas in the United States and Canada can have important climatic effects over the North Atlantic region.

The Azores islands provide a unique natural laboratory to study the effects of anthropogenic emissions on the atmosphere over the North Atlantic Ocean, because the impact of local pollution sources is considered to be minimal. In addition, the islands are the only location in the central North Atlantic where ground-based measurements of the atmosphere are possible.

The objective of this project is the continuous measurement of atmospheric levels of BC at two remote sites in the Azores islands, in order to determine the frequency and magnitude of long-range transport events that disperse this air pollutant. Altitude differences in BC transport over the central North Atlantic Ocean will be investigated from measurements performed simultaneously in the boundary layer (Terceira Island) and the free troposphere (summit of Pico Island). The information gathered from this project will provide further insight into the spatial and temporal distribution of BC and add to the growing database of BC concentrations in the global atmosphere. In addition, these measurements will improve current understanding of human impacts on the North Atlantic atmosphere and will contribute to improved estimates of the influence of BC in climate change.

Title

REDUCTION OF UNCERTAINTIES OF ESTIMATES OF ATMOSPHERIC EMISSIONS FROM FIRES IN SOUTHERN AFRICA.

Proposing Institution

Universidade Técnica de Lisboa - Instituto Superior de Agronomia – ISA

Summary

The goal of this project is to contribute towards the reduction of uncertainties in the estimates of emissions of trace gases and aerosols resulting from biomass burning in southern Africa. The specific objectives are: to develop burned area detection algorithms using data from the newest generation of instruments of the NASA Earth Observing System; to improve estimates of combustion completeness in the Miombo ecosystems of southern Africa; to study the relationships between land use/land cover and fire.

The core of the project is the development and application of new methods of burned area detection and mapping using the new generation observation systems (TERRA sensors, and SPOT-4 Vegetation). Reliable quantification of burned area and combustion completeness have been pointed as a major limiting factor on the ability to reduce the high variability of the currently available emissions estimates. Collaboration with NASA's Goddard Space Flight Center will facilitate the development of burned area detection algorithms for the new generation of satellites, and access to the knowledge gathered by this team during the SAFARI-92 campaign. All activities of the project are coordinated around a participation in the SAFARI 2000 campaign (Southern Africa Fire-Atmosphere Research Initiative), an international collaborative science initiative that takes place in southern Africa and comprises (1) a number of linked ground based short and long term field campaigns to measure biological, soil atmosphere and radiation processes, (2) aircraft measurements of vertical and horizontal properties of the atmosphere, (3) remote sensing observations from NASA's new generation of Earth observation systems.

The tasks proposed in this project are of two types:

- algorithm development, image processing, statistical analysis, geographical data processing and analysis, and generation of maps;
- fieldwork for ground validation of the image classification, fuel and combustion efficiency measurements, and spectro-radiometric measurements.

The fieldwork will be conducted mainly at a study site in Northern Mozambique (one of SAFARI's network of ground based study sites). The Portuguese team is responsible for the operations in this site, which will be coordinated through Universidade Eduardo Mondlane, Maputo.

The results expected are: an algorithm for burned area detection at 1 km spatial resolution adapted to the major ecosystems of southern Africa; a set of 1 Km resolution burned area maps for the same region; a high resolution burned area map-set for accuracy assessment; a field data base with ground data information; improved estimates of combustion completeness in Miombo ecosystems; a characterization of fire spatial and temporal patterns by land cover type; and an estimate of biomass burning and atmospheric emissions by land cover type, for the SAFARI 2000 study area.

Title

CLIMATE CHANGE IN PORTUGAL: IMPACT ON THE OCCURRENCE OF FOREST WILDFIRES AND ON THE AIR QUALITY

Proposing Institution

Universidade de Aveiro

Summary

Attending to the fact that climate change is regarded as one of the main threats to world-wide sustainable development, the principal purpose of this project is to provide a base of scientific information for national policy makers and public use by the assessment of the vulnerability of Portugal to climate change, namely in what concerns the occurrence of forest wildfires and the air quality. Human activity is responsible for an increase of the greenhouse gases (GHG) and aerosols concentration's in the atmosphere, contributing to an increase of the greenhouse effect. Several studies using climatic general circulation models (GCM), and assuming different scenarios of GHG concentration point to important global changes in temperature, precipitation and soil moisture content. At a regional level potential changes were identified, which concern ecosystems composition and their productivities, severe extreme high temperature events, floods, and drought (which are closely related to forest fires occurrence). However, the horizontal resolution of present coupled atmosphere-ocean models is still too coarse to capture the effects of local and regional forcing in areas of complex surface physiography and to provide information suitable for many impact assessment studies.

This project intends to evaluate climate change impacts on Portugal with a technique that consists of using outputs from a GCM (MUGCM) simulations, estimated for a present climate and for a climate submitted to an increase of carbon dioxide concentration in the atmosphere, to provide initial and driving lateral meteorological boundary conditions for a high resolution regional climate model (MM5). The vertical profiles resulting from MUGCM applications will be validated with historical radiosoundings data sets, which will provide better initialisations of the regional model MM5. MM5 results will be validated with reanalysis data sets from the European Centre for Medium Range Forecast. Fire meteorological risk indexes for Portugal will be estimated using the regional meteorological results both for control and for perturbed global climate simulations. Different methodologies will be applied, namely: the Canadian Fire Weather Index, the Nesterov Index (modified by the Portuguese Meteorological Institute) and the Haines Index (calculated from radiosounding meteorological data). Aiming to compare and to evaluate the different estimated indexes a meteorological field campaign will be performed, in the centre of Portugal, during one fire season. On the other hand, the impact of climate change on photochemical production and on the air quality will be calculated using a numerical system of models to simulate the transport and photochemical production (MEMO/MARS) on Portugal, with a dynamical downscaling approach. The national emissions database of the University of Aveiro will be used to estimate present air pollutants emissions, both biogenic and anthropogenic one, in order to be included in the air quality system. Regarding simulations considering a future climate, several emission scenarios will be built. Different factors such as economic growth patterns, trends and characteristics of energy consumption and intensity, the influence of specific co-ordinated policies and measures at national and European Union level will be considered. Results from this project would be useful for future policy decisions regarding forest and air quality management.

Title

PORTUGUESE WOOD INDUSTRIES: GREENHOUSE GASES FLUXES AND ACCOUNTING METHODS FOR THE EVALUATION OF THE GLOBAL WARMING EFFECT

Proposing Institution

Universidade de Aveiro

Summary

The adoption of the Kyoto Protocol in December 1997 implies the development of a series of policies and measures at national level to ensure that the quantified targets for greenhouse gases (GHG) reduction are met in the period from 2008 to 2012. The wood industries are a very important industrial sector in Portugal and they are in a good position with regard to GHG emissions. In fact they use a renewable material as raw material, wood, that act as a carbon sink when is taken from sustainably managed forests, and also because the energy consumed in this industry is largely based on renewable fuels. In addition most of forest products contribute to the storage of carbon through the products storage.

The main goal of this project is to provide a decision-supporting tool for the establishment of strategic policies for the wood industries and Portuguese government in order to meet the Kyoto Protocol's target concerning the global warming effect. One objective of the project is the identification and quantification of GHG emissions and removals along the life cycle of the products from wood industries. The subsystems considered are, among others, the following: forest growth and management, wood products production, recycling, different final disposals (landfilling, incineration, etc.) and transportation.

The methodologies used to estimate GHG emissions and removals are those accepted by the IPCC (Intergovernmental Panel on Climate Change), according to the Kyoto Protocol recommendations.

Another objective is the comparison between different models for carbon accounting (such as, IPCC default method, atmospheric-flow approach, stock-change approach and production approach). When applied to the Portuguese forest, this comparison is based on sensitivity analysis and considers the following quality criteria: accuracy, simplicity and scale independence.

The main result of this project is to gain knowledge and understanding of the technical and political implications of choosing one carbon accounting method applied to the Portuguese forestry

Title

CARBON BALANCE OF EUCALYPT PLANTATIONS IN PORTUGAL – THE KYOTO FOREST PROBLEM

Proposing Institution

Universidade Técnica de Lisboa - Instituto Superior Técnico – IST

Summary

The main goals of the project are to study the magnitude, seasonal variation and distribution between ecosystem components of carbon stocks and fluxes in eucalypt plantations and their potential role as carbon sinks in the context of the Kyoto Protocol.

More specifically the project aims at:

(1) quantifying the net ecosystem carbon exchange through the continuous measurement of surface flux of CO_2using the eddy covariance method, on a flux tower installed on a 8 years-old eucalypt plantation, and the partition of this flux between plant CO_2 exchange with the atmosphere and soil respiration. This is the flux which, if summed annually, provides the estimate of Net Ecosystem Exchange (NEE), and thus provides a direct measurement of the annual ecosystem carbon source/sink strength, which shall be compared with the stock inventories for carbon accounting in the Kyoto protocol commitment period.
(2) The quantification of carbon stocks by the inventory of biomass components and changes in soil carbon storage along a chronosequence of eucalypt plantations in Herdade da Espirra.
(3) To extrapolate the results found for carbon sequestration in the main site, across a range of soil and climate conditions in Portugal using adequate models.

This study will be done using data collected by the group for more than two decades and the validation of the results in the Herdade da Espirra, a site has been extensively studied in terms of soils, hydrology and biomass production leaf physiology and leaf area index.

Title

AQUIFERS AS ARCHIVES OF PALAEOCLIMATE AND INDICATORS OF FUTURE CLIMATIC SCENARIOS - SADO - SINES SYSTEM AND BAIRRADA CARSIC AQUIFER

Proposing Institution

Universidade de Lisboa – Fundação da Faculdade de Ciências

Summary

The Sado-Sines System represents an important water resource for a vast region (Sines-Grândola-Setúbal-Alcochete). The highly populated urban and industrialised areas of Sines and Setúbal are mainly supplied by this system, which has been extensively exploited over the recent decades. In the remaining region the agricultural and cattle breeding activities are also depending of this resource. Concerning the Bairrada Carsic aquifer, this is mainly composed by carbonate formations (Liassic), and represents a vital water resource for public supply in that region (Anadia, Cantanhede, Mealhada, Montemor-o-Velho and Oliveira do Bairro).

This project will contribute to a better understanding of Sado-Sines System and Bairrada Carsic Aquifer, updating the knowledge of the dynamic evolution response in time of both systems, using chemical, physical and isotopic determinations. The comparison of Sado-Sines system characterised by a long residence time, with the Bairrada Carsic Aquifer (fast circulation) will allow to determine the influence of the climatic variations in precipitation, along hydrological cycles since Pliocene to present and predict future climatic scenarios.

Isotope data enabled a reconstruction of the hydrodynamic response of the system to dramatic changes of climate. Stable isotopes will be used in the identification of the salts contamination sources in groundwater (salt dissolution and seawater intrusion). 14C determinations will be performed along the main flow path of the system. The apparent flow velocities gives information about the aquifer response to the sea level changes (Sado-Sines System), also reflected in the chemical evolution of the groundwater. The identification of pollution mechanisms (seawater intrusion actual/ancient and agricultural or cattle breeding activities (15N)) using traditional chemical tools associated with isotope techniques, delimitation of recharge areas and estimation of residence time and flow velocities are the first goals to be achieved in Sado-Sines basin; in parallel, the application of environmental isotope techniques (2H, 13C, 15N, 180 and 3H, 14C) together with chemical analysis and noble gases measurements will give information about palaeoclimatic and palaeohydrogeological evolution of the area and the response of the system to the sea level changes estimating the palaeoflow velocities. Concerning the Bairrada Carsic aquifer, the characterisation of its hydraulic behaviour and hydrochemical evolution along the flow path, will contribute to a correct water management and identification of its vulnerability to anthropogenic pollution.

Title

OIKOMATRIX - EVALUATION OF THE SOCIO-ECONOMICAL IMPACT OF LEGAL TOOLS TO CONTROL THE EMISSION OF GREEN HOUSE GASES

Proposing Institution

Universidade de Aveiro

Summary

Portugal has been experiencing a remarkable economic growth in the last years. This growth was reflected in an increasing use of resources, namely fossil fuels, with a significant contribution for the increase of greenhouse gases emission. With the Kyoto Protocol in 1997, and considering the state of relative development of the country in the frame of the European Union, Portugal obtained the right to increase its emissions of carbon dioxide up to 27% till 2010, comparing to 1990 levels. This 'right' will be depleted in 2000, according to more pessimistic scenarios: the emissions increased in these three years about 37% (Seixas et al., 1999).

Using a 'business as usual' scenario, results show that Portugal is close to reaching or even surpassing the values agreed upon in Kyoto (Borrego et al., 1999a and b). Considering the assumed commitments, Portugal will be forced to acquire rights of emission with costs estimated in over 1 GEuro per year. In this context it is obvious the need to implement measures in order to oppose and invert these trends. In the frame of this project an evaluation of the economic impacts due to the introduction of policies to limit the use of energy with generation of carbon dioxide from non-renewable sources will be performed. This evaluation will be based on national, single-region and multi-regional input-output economic matrices.

The goals are, on the other hand, to follow and evaluate the evolution of the emissions of carbon dioxide in Portugal and to assess the impacts on the economy of the legal measures to adopt, both at national and regional levels. The evaluation of the effect of different alternatives will be done by the construction of scenarios that will include estimates of the effect of:

- the technological improvement;
- the introduction of new products or alternatives;
- the reduction of production and/or the consumption;
- the changes of fuel consumption patterns in industry, houses and transportation.

These scenarios will be translated, when adequate, in an update of the technical coefficients of the economic matrices. The evaluation of the direct effects of the different measures will be based on the existing experience in the team in this domain and the extrapolation of the effects of similar implementations in other countries. The final project goal is to establish both a methodology to estimate environmental impacts from changes on the economic activities and to apply the economic matrices for the evaluation of the impact of new legal measures in the domain of the environment, both at national and regional levels. These methodologies may be the basis of a decision support system, generating regional cost-benefit and multi-criteria analysis.

Title

BUILT ENVIRONMENT, URBAN CLIMATE AND RATIONAL USE OF ENERGY

Proposing Institution

Instituto Nacional de Engenharia, Tecnologia e Inovação – INETI

Summary

In the panorama of the Portuguese energy sector, the buildings are responsible for about 20% of the consumption. This value is prone to increase, in response to expectations of the citizens for higher comfort levels. The energy bill is usually a significant portion of the operation costs of buildings. Energy use is also closely related to environmental problems such as global and local climate change. Both are good reasons for having the energy use in the built environment as one of the main targets for policies of energy savings, rational use of energy and greenhouse gas emission reductions.

The use of energy in buildings is naturally related to the materials and components used - but also by factors such as occupancy patterns, location, shape, etc. In particular, factors such as the surrounding climate and microclimate are very important, as quite large variations in ambient temperature, humidity and wind speed and direction can often be found within a same location. A correct adaptation of the buildings to their environment is crucial for optimisation of both human comfort and energy use.

An on-going PRAXIS Project (SIAM) is currently examining the impact of climatic change in Portugal, including in the Energy sector. The impact of global climate change in the use of energy in buildings is one of the main issues surveyed.

The current Proposal (ACLURE) focuses on the local scale. The influence of urban climate variability and human induced climate changes on energy use in buildings (and comfort) will be analysed through measurements and simulations for a variety of typical cases. Subjects of study will be the influence of vegetation, large water bodies, average volumetry of the area, shading, street canyons; size of the urban aggregate (e.g. heat island effect); and type, shape and constructive details of buildings.

The outcome of this Project should be translated into models and methods for assisting in estimating the urban microclimate, its effects on the thermal performance and energy use in buildings and guidelines for building placement and design. Case studies will be analysed. A brochure will be published. Also a ready-to-use tool decision aid for professionals - such as architects, engineers, decision-makers - will also be implemented as a Geographical Information System coupled to an Expert System, however carefully designed to be "light" so as to run easily and fast in a common desktop computer.

2001

Title
CLIMATE CHANGE IN PORTUGAL – SCENARIOS, IMPACTS AND ADAPTATION MEASURES (SIAM)

Proposing Institution
Universidade de Lisboa – Fundação da Faculdade de Ciências

Summary

Climate change is one of the most serious environmental problems facing the earth today. The Intergovernmental Panel on Climate Change (IPCC) revised its conclusions of 1995, in which it stated "…the balance of evidence suggests that there is a discernible human influence on global climate…" to "…there has been a discernable human influence…" in its 2000 preliminary version. It is a fact that the systematic increase in anthropogenic emissions of greenhouse gases, among which CO2 is most prevalent, causes climate change. These changes are hardly reversible, and have negative impacts in many regions and countries.

The combustion of fossil fuels (coal, oil, etc.) and the changes in the use of land, namely forestry are contributing to the increase in the concentration of greenhouse gases in the atmosphere, changing the thermal balance, heating the atmosphere in some regions and cooling in others. As aerosols do not remain in the atmosphere for long periods of time and their concentration is not foreseen to substantially increase, these cannot compensate for the long-term effects of greenhouse gases (which have long atmospheric residence times).

The main goal of this proposal is to report on the potential effects of climate change in Portugal. This report will provide, on a regional basis, a compilation of the available information on the vulnerability of ecosystems, human health and socio-economic sectors to climate change. The vulnerability of social and natural systems to climate change will be evaluated according to a systematic and integrated process. Uncertainties regarding the characteristics, magnitude and future climatic variation indices create limitations on climate change impacts projections, especially at the scale of a country such as Portugal.

This study has four objectives:

1 – Creation and analysis of climate scenarios for different time intervals to 2100;
2 – Quantitative assessment of the impacts of climate change on different sectors and socio-economic activities;
3 – Identification of vulnerability to annual and seasonal meteorological variations by different sectors and activities;
4 – Study and identification of possible response and adaptation measures with regard to climate change impacts.

Title

STUDY OF FORCING MECHANISMS OF LOW FREQUENCY ATMOSPHERIC VARIABILITY IN THE EURO-ATLANTIC REGION

Proposing Institution

Universidade de Aveiro

Summary

Much of the energy that feeds the extra-tropical atmospheric systems originates in the excess of energy in the tropics, which is meridionally transported to the extra-tropics by the Hadley circulation. Superimposed on the Hadley Circulation, one observes throughout the equatorial region, a series of zonal direct thermal cells named the Walker Circulation, its ascending branches corresponding to regions of strong superficial convergence and intense precipitation located over Indonesia and west Pacific, Amazonia and Southern Africa.

Perturbations of these important general circulation mechanisms can have consequences on the climate and its variability (on an inter-annual and in longer temporal scales) in some regions of the planet. In particular, it is known the influence of the El Niño-Southern Oscillation phenomenon (ENSO) in the structure of the Walker Circulation. Less addressed has been the impact of these changes on the Hadley Circulation, particularly in the Euro-Atlantic region. Much of the research carried out so far on the influence of ENSO on European climate links the propagation of the ENSO signal through of a wave train which propagates across the Pacific, North America and North Atlantic. Recent concerns on the desertification of the Mediterranean and southern Europe regions, which may or may no be related to ENSO, resulted in a number of local climate studies of these regions seem to confirm this tendency. However, the physical mechanisms behind these changes remain obscure. Thus, it seems a reasonable scientific hypothesis the existence of physical mechanisms related to the variability of the meridional circulation, which force extra-tropical low-frequency variability.

In winter, when the westerly winds predominate in the extra-tropical stratosphere, the troposphere and stratosphere are dynamically coupled. Thus, the effect of the tropical/extra-tropical connection could be different, depending on the characteristics of the coupling between the two atmospheric layers.

In this project, one intends to perform a series of 20 simulations with the Melbourne University General Circulation Model, to study the atmospheric inter-annual climate variability of the Euro-Atlantic tropics/extratropics interface region. In these simulations the atmosphere is forced with lower boundary conditions (sea surface temperature and sea-ice) observed during the 1979-96 period. Each of these simulations differs in the initial conditions. With this approach one can separate the total variability into forced (due to the temporal evolution of the boundary conditions), and internal variability. This allows also the separate study of the anomalous energy excess (El Niño) and deficit (La Niña) in the tropics to which the extra-tropical circulation may not respond linearly.

The effect of the dynamical coupling between the troposphere and stratosphere will be studied. The analysis will be performed also on observed data and, if necessary, on simulations available from other models.

Title

CLIVAR - CLIMATE VARIABILITY AND CHANGE: PATTERNS AND IMPACTS AT THE REGIONAL SCALE

Proposing Institution

Instituto de Ciências da Terra e do Espaço – ICTE

Summary

Project CLIVAR proposes to clarify some aspects of the Iberian regional climate which are important both for downscaling of long-term and seasonal weather predictions and for climate change assessments. CLIVAR will study relationships between the large scale circulation and its variability, and the regional features which are due to the Iberian geometry, topography, soils and land use. The aim is not only to explore the regional aspects of climate variability and change, but also to assess the interactions between expected climate change, coming from increased greenhouse gases concentrations at the world level, and other climate change forcing associated with changes in land use at the regional and local levels.

The methodology to be used brings together some new methods from statistical climatology, which can be used to design highly efficient weather classification systems, and state-of-the-art mesoscale modelling techniques, allowing for a detailed simulation of case studies at the sub-regional scale.

At the same time, because agriculture is one of the main potential end users of improved seasonal forecasts, the project will also test the impact of seasonal forecasts and climate scenarios on the agriculture system, again by direct numerical modelling, allowing for the analysis of model sensitivities to the available parameters.

It is expected that Project CLIVAR will contribute to a better understanding of the regional aspects of climate variability, which are essential for the understanding of the most relevant issues of climate change and its impacts.

Title

GENETICLAND: DISCOVERING FUTURE LANDSCAPES UNDER CLIMATE CHANGE SCENARIOS USING GENETIC ALGORITHMS

Proposing Institution

Instituto do Mar - IMAR

Summary

Climate changes have repercussions in the landscape. Some of them may be good, but others may be disastrous for the world environment therefore, it is important to study how the landscape is going to evolve due to these changes. The purpose of this project is to shed some light into this topic. Specifically, we address the following question: given forecasted data on climate changes, is it possible to predict how the landscape will look like in the next 50 years? We believe it is possible to do so with the aid of computer simulation incorporating multi-scale processes and patterns, and utilizing genetic algorithms to simulate landscape evolution.

The simulation of future behaviours of physical systems under climate change scenarios raises the possibility of improving the state of knowledge of the physical systems' underlying processes.

Some examples include the relationships between hydrological processes at the land surface and processes within the atmosphere (see http://www.cais.com/gewex/projects.html). Although some progress has been made, the assessment of related impacts (e.g. soil erosion) have been constrained by three issues: (1) the limited understanding of processes relating climate forcing and hydrological responses, (2) the lack of methods to couple different multi-scale (space and time) processes and patterns, and (3) the lack of techniques to generate future system states according to forecasted variables.

The theoretical foundations for this work come from two major areas: methods to couple multi-scale processes designed by different simulation models, and methods to generate spatial states under known local constraints and global optimization goals. Practical motivation comes from the recent conclusions on the future climate for Southern Europe (IPCC, 2001), with increases of the frequency of intense precipitation events (very likely -90-99% chance- to occur), and summer drying and associated risk of droughts (likely - 66-90% chance - to occur). Lavee et al (1998) showed that relatively small changes in the climate may push many Mediterranean areas into a more arid and eroded landscape. That's precisely what is likely to happen in Southern Alentejo, a region that was identified as a changing landscape with decreasing carrying capacity (Seixas, 2000). It is our purpose to use Southern Alentejo as a case study to test our research methodology.

For simplicity and feasibility, the major driving force governing the carrying capacity of semi-arid landscapes is assumed to be hydrological soil erosion. Within this framework, the project has two novel research goals. The first one is the development of a method to integrate both large scale (Cornell ref, 2000) and small scale (Nunes et al, 2000) physical processes governing soil erosion. The second one is to design a genetic algorithm capable of generating landscapes according to global objectives (e.g., minimization of soil loss, maximization of net primary productivity), subject to local constraints (e.g., spatial coherence) and guiding requirements (e.g. policy land uses). Therefore, new contributions for genetic algorithms and multi-scale simulation methods are expected. Methods of scientific visualization of future synthetic landscapes will be worked with impact on the project final product. Moreover this project aims to give insights for the potential disruption of the Southern Alentejo landscapes under climate change scenarios.

Title

OIKOMATRIX II – EVALUATION OF THE SOCIO-ECONOMICAL IMPACT AT REGIONAL LEVEL OF LEGAL TOOLS TO CONTROL THE EMISSION OF GREENHOUSE GASES

Proposing Institution

Universidade de Aveiro

Summary

The relatively high growth rate of the Portuguese economy leads to a significant increase in the use of fossil fuels and, consequently, in the emission of greenhouse gases (GHG). This GHG emission growth is now clearly associated with the growth on the transportation sector - eventually reaching a 100% increase by 2010. Portugal is now near the limits assumed with the Kyoto Protocol for its CO_2 emissions and, at this rate, by 2010 it could be paying a GEuro/year on emission rights. The measures/ policies to invert this trend will have socio-economical impacts that may affect differently the various economic sectors and regions.

The team involved in Oikomatrix has been working in these domains. Major sources of CO_2 are being added and updated and input-output modelling have been used in this areas of interest; contacts with other European teams working in this field were reinforced. In the beginning of 2002 a technical basis will be produced to support the generation of legal measures in what concerns GHG emissions, together with an operational input-output model including environmental aspects.

The work described in this proposal will take this research further onto the evaluation of the socio-economical effects at the regional level (considering five mainland regions in Portugal) and the effects down into the enterprise scale - including the effect of necessary investments on product costs, enterprise profitability and competitiveness. The regional effect evaluation will be based on national, single-region and multi-regional input-output economic matrices.

The goals are to follow and evaluate the evolution of the emissions of CO_2 in Portugal and to assess the impacts on the economy of the legal measures to adopt, both at regional and enterprise levels. The evaluation of the effect of different alternatives will be done by the construction of scenarios that will include estimates of the effect of:

- the technological improvement;
- the introduction of new products or alternatives;
- the reduction of production and/or the consumption;
- the changes of fuel consumption patterns in industry, houses and transportation.

These scenarios will be translated, when adequate, in an update of the technical coefficients of the economic matrices. The evaluation of the direct effects of the different measures will be based on the existing experience in the team in this domain and the extrapolation of the effects of similar implementations in other countries.

The final project goal is to establish both a methodology to estimate environmental impacts from changes on the economic activities and to apply the economic matrices for the evaluation of the impact of new legal measures in the domain of the environment, both at national and regional levels. An enterprise level effect will also be assessed complementarily. These methodologies may be the basis of a decision support system, generating regional cost-benefit and multi-criteria analysis.

2002

Title

VAST - VARIABILITY OF ATLANTIC STORMS AND THEIR IMPACT ON LAND CLIMATE

Proposing Institution

Universidade de Lisboa - Fundação da Faculdade de Ciências

Summary

The new generation of climate databases, including the ERA-40 reanalysis results that will be soon released, and output from numerous GCM simulations of present climate and different climate change scenarios, allow the development of sophisticated interpretation techniques that help us to understand the physics of climate variability and change.

In mid-latitudes, significant weather in a given location is produced by the action of the active meteorological systems. Because most of our interest in weather is associated with either precipitation distribution or extreme events (e.g. strong winds) it is clear that changes in the atmospheric circulation are of great relevance when they are associated with changes in the mean storm intensity or in their trajectories.

Project VAST aims to develop algorithms for automatic storm detection and storm tracking, which are applicable to the North and South Atlantic storm tracks. The algorithms will identify individual storms from gridded meteorological data, classify its time varying intensity and will follow the storms along their tracks. Output from that analysis, that is the temporal evolution and position and intensity of each storm, will be used to compute monthly and seasonal statistics of storms in different areas of the Atlantic basin. The storm statistics will then be related with observed climate variability indices, namely low-frequency modes (NAO, ENSO, Antarctic Oscillation) and precipitation statistics in three key areas: Southwest Europe, South America and the Azores.

Project VAST will also try to extend the storm tracking algorithms to the analysis of tropical weather. Because of its smaller scale and signature, this is a difficult task, but the relative high resolution and parameter richness of the new reanalysis may provide just enough detail to get useful information.

Title

SIGN - SIGNATURES OF ENVIRONMENTAL CHANGE IN THE OBSERVATIONS OF THE GEOPHYSICAL INSTITUTES

Proposing Institution

Instituto de Ciências da Terra e do Espaço – ICTE

Summary

The three Portuguese Geophysical Institutes, in Lisbon, Oporto and Coimbra, were established in the 19th century and have since their foundation maintained continuous series of Meteorological and Geophysical Observations. These data constitute the richest Portuguese repository of Earth observations, including important Climate Change data, long-term geomagnetic measurements and many seismological records. However, most of that data is not accessible to researchers because it has never been converted to digital format.

Project SIGN joins, for the first time in many decades, the three Geophysical Institutes, in an integrated effort to recover the historical meteorological and geophysical records, make them available to a large community of users, and use them to investigate the changes that have taken place in our geophysical environment in the last 150 years.

In what concerns to meteorological records, SIGN will produce a complete dataset of daily observations, including raw data, derived quantities and homogenized monthly values of the main variables. The project will also focus on the analysis of data that has been generally overlooked in climate change assessments, like cloud cover, sunshine hours or soil temperatures, and will look at changes not only in the mean but also in the extremes.

The Coimbra Magnetic Observatory has been operating for over 140 years, providing valuable data for a wide range of studies in geomagnetism: calibration and control during aeromagnetic and satellite surveys; monitoring and forecasting of magnetic storm activity; monitoring of secular variation of the magnetic field for studies of the Earth's deep interior.
During this period, a large amount of magnetograms recorded on photographic paper has been produced. These magnetograms contain information, which cannot be found elsewhere, on the high frequency variations of the geomagnetic field produced by sources (currents) lying in the magnetosphere and ionosphere. As scientists gain new insight into geomagnetic and solar activities, they become aware of the main defining features of the short-term events such as geomagnetic storms and sudden commencements (SC). Old magnetograms need then to be checked in search of those features, not only for studies of historical geomagnetic activity but also as an important test for new theories and models.

In what concerns seismological data, the Project will digitize all available records corresponding to earthquakes generated in and around Portugal, estimated to be of the order of 1000 events in the past century (with magnitudes above 3).

Title

ASSESSMENT OF CLIMATIC CHANGE IMPACT ON WATER RESOURCES AND CO2 FIXATION IN FAST GROWING FOREST STANDS IN PORTUGAL

Proposing Institution

Universidade de Aveiro

Summary

Recent work witnesses the important impact that climate change will have upon evapotranspiration rate and therefore water resources availability for fast growing forest stands in Portugal. This will be particularly important under the foreseen scenarios of a decrease in annual rainfall for Southern Europe (Parry, 2000). In addition, water stress is predicted to occur for some forest species (Coelho et al., 2001), leading to changes in stand growth, litter layer dynamics, water consumption and atmospheric CO_2 fixation, which will affect the calculations to meet the Kyoto protocol assignments. On the other hand, the impacts of climate change on soil and slope/catchment hydrological processes are not well understood and require further research to facilitate improved management of water, an important natural resource. Soil moisture is critical in these processes since it plays an important role on plant growth rates, litter layer decomposition rates and on slope and catchment hydrological and hydrochemical processes.

This project uses a multiple scale approach comprising a series of unbounded plots where soil moisture pattern is measured through permanent TDR probes, bounded plots where slope hydrological processes will be assessed and small instrumented catchments with dominant land uses which will be used to characterize runoff and evapotranspiration. Tree growth and litter layer decay rates will be monitored on a monthly basis throughout the project, with more intensive sampling during key periods to assess the impact of various weather patterns. Analysis of the results will enable the mechanisms of interaction between climate change, plant growth, hydrological processes and water resources availability to be established.

The environmental impact of predicted climate scenarios (Parry, 2000) on water resources in terms of changes in vegetation interception rate, soil moisture patterns, slope and catchment hydrology, and on CO_2 fixation in terms of trees/shrub growth rates and litter layer dynamics will then be assessed for a range of eucalyptus forest stands. The data obtained will be used to calibrate the Globulus 2.0 growth model in order to estimate productivity of fast growing stands inside each watershed and the relationship with evapotranspiration rates, soil hydrological properties and processes and catchment runoff response. Using the national forest inventory data, results will be extrapolated on a national scale for different climate change scenarios.

Title

ADAPTATION OF PINE SHOOT BEETLE TO HOST PINE PHYSIOLOGY UNDER THE INFLUENCE OF CLIMATE CHANGE

Proposing Institution

Universidade Técnica de Lisboa - Instituto Superior de Agronomia – ISA

Summary

The sustainability of pine forest ecosystems, widely present in Portugal for wood production, soil protection as well as landscape quality, is a priority of forest policy.

Bark beetles are generally considered among the most important limiting biotic factors of pine forests. They affect the productivity of pine stands, either by directly killing living trees or as vectors of pathogenic organisms. A favourable influence of climate change on this insect guild is likely to occur in consequence of changes on their host tree physiology. Increased temperature and drought stress may favour bark beetles due to changes on the phloem nutritional quality as well as a depletion of secondary defensive components in host plants. In contrast plants growing in enriched CO_2 conditions could be more able to compensate water-stress. However results achieved so far are not conclusive and little knowledge is available of how these conditions will affect insect-plant interactions.

Other disturbances predicted, such as increasing fire risk and windstorms, may amplify bark beetle attacks by increasing available material for insect breeding. The pine shoot beetle (*Tomicus piniperda L.*) is one of the main pests in Portugal associated with pine stands and particularly promoted by forest fires. Its possible coexistence with the close species *T. destruens* raises further questions both of scientific and practical relevance which we aim to clarify through the following specific objectives:

1) To analyze the genetic diversity among populations of *T. piniperda* and *T. destruens*, and relate it to their bioecology, in particular assessing population dynamics parameters, as an indicator of possible adaptation to local conditions and host species;
2) To decode and identify differences in the main semiochemicals involved in the process of host selection and colonization by the two species and their populations;
3) To assess the effect of climate changes in tree physiology due to drought stress and CO_2 enrichment in the colonization and performance of the two species.

Genetic differentiation of local populations of *T. piniperda* and *T. destruens* will be analyzed by collecting individuals in several regions, seasons and on different pine species for DNA analysis. In parallel studies on the two bark beetles' populations related to host tree species will be conducted by using logs and young plants from different species in field and laboratory trials. Bark beetles attraction behaviour towards different pine species will be further related to the species monoterpenes emissions and/or contents, determined by gas chromatography analysis. The performance of these insects in relation to host tree physiology will be further analyzed by using trees watered and under drought stress, combined with elevated CO_2 atmosphere and at environmental conditions. Several tree physiological and insect performance parameters will be evaluated.

Title

EFFECTS OF ELEVATED CO_2 AND INTERACTING ENVIRONMENTAL VARIABLES ON GRAPEVINES GROWN UNDER MEDITERRANEAN FIELD CONDITIONS

Proposing Institution

Universidade de Trás-os-Montes e Alto Douro

Summary

Over the past 230 years since the beginning of the industrial revolution the amount of CO_2 in the atmosphere has been increasing as a result of the use we have been making of fossil fuels. The concentration has risen from 270 ppm to 365 ppm and is continuing to rise at an increasing rate which is at present about 1.5 ppm per year. This might cause major climatic changes. Global warming and shifts in amount, seasonality and distribution of precipitation will occur. It is, therefore, essential to understand the response of crops to the elevated levels of CO_2 by trial experiments in the field in order to obtain realistic data on crop responses for use in crop models. The impact of increasing atmospheric CO_2 on crop systems is of considerable importance to realize the crop productivity and food security in future. Thus, for impact assessment analysis of global increase in CO_2, it was considered important to generate a database on plant responses to locally elevated CO_2 concentration. Relatively little information is available on the interaction of the elevated CO_2 and interacting environmental variables on growth and physiology of grapevines, and none, of our knowledge, was performed in Portugal, where viticulture is the main agricultural activity.

A team of 11 researchers, with different academic formation, such as agronomy, biology, biochemistry and oenology, from 4 Departments of the University of Trás-os-Montes e Alto Douro will participate in several tasks including analysis of phenology, soil and plant elemental analyses, foliage characteristics (leaf area, main and lateral leaf number, degree of foliage exposure), vigour, canopy microclimate, vine physiology and anatomy (light use efficiency, water relations, sap flow, leaf gas exchange rates, photosynthetic proteins and lipids, chloroplast bioenergetics, metabolites, antioxidants activities, leaf and stem anatomies), yield, fruit composition (control of grape maturation), winemaking and analytical characterization of wines. All of the data will be assembled in a standard format for validation of grapevine growth models. To this end experimental facilities to study the response of grapevines to elevated CO_2 and the variation on the physiological, structural and biochemical processes of grapevines in response to the interaction of elevated CO_2 (550 ppm), moisture stress and temperature and their consequences on the yield and vine quality. In addition to these objectives, the project aims the academic formation of students, namely of master and graduation degrees.

2003

Title

LONG TERM REMOTE SENSING OF ATMOSPHERIC TRACE GASES OVER PORTUGAL BY COMBINED GROUND BASED UV-VIS SPECTROMETER AND SATELLITE REMOTE SENSING.

Proposing Institution

Universidade de Évora

Summary

Ozone and the atmospheric chemical related compounds are important regulating factors of the Earth's climate through the absorption and scattering of solar radiation. In addition, the columnar and vertical profiles of these gases may suffer variations due to anthropogenic and natural emissions of interfering compounds.

In this regard, the studies of chemical and dynamic processes involving the stratospheric trace gases, as well as the tropospheric ones are very important since they prompt remarkable contributions to the climate change process. The double aspect of the ozone effects is well known: it works as a filter for the UV-A and UV-B radiation in the stratosphere (the ozone bulk is located at 20-22 Km of altitude), but it is a very dangerous pollutant in the lower troposphere. The interactions between ozone and chemical related compounds (mainly NO_2, HCHO, BrO, IO) can produce significant variations in the ozone total content as well as in the location of the ozone bulk. The so-called "ozone hole", occurring in the stratosphere during the spring season for the Polar Regions, can also reach the mid-latitudes (as evidenced by the last Match campaigns).

Portugal is at the border of the European continent, but it can be reached by ozone-depleted air masses, depending on the meteorological conditions. On the other hand, during summer, the polluted air masses from Eastern Europe or from the coastal industrialized cities (Lisbon, Oporto and Sines), driven by the main circulation, can determine increases of the tropospheric ozone content as well as of the atmospheric pollutants, due to the high temperature of the continental Portuguese regions. Undoubtedly, satellite observations have determined a remarkable advance in the study of the atmospheric processes, but the ground-based measurements must equally be used in order to validate the satellite results. In addition, the ground-pixels of the satellite borne spectrometers, utilized in this study (SCIAMACHY and GOME), are too large (respectively 240-80x30 and 320x40Km2) to allow for local/regional scale studies of atmospheric trace gases.

This proposal aims to improve the characterisation of the fluctuations of the atmospheric trace gases content and to study the influences of these fluctuations over the local, regional and global climate change. The proposed methodologies are based on the combination of observations from different platforms (multispectral satellite data with high spectral resolution and ground based measurements). This is the first time in Portugal that studies on atmospheric compounds and pollutants are carried out from satellite and ground based data. This activity would contribute for the advance of climate studies in the Mediterranean regions.

Title

CARBERIAN - TERRESTRIAL VEGETATION CARBON TRENDS IN THE IBERIAN PENINSULA EXPLORATORY ANALYSIS FROM NORTHERN ATLANTIC OSCILLATION RELATED BEHAVIOR

Proposing Institution

Instituto do Mar – IMAR

Summary

The study of spatial and temporal vegetation trends is of high importance concerning the carbon cycle biosphere component, which is presently a challenging issue both at scientific level as well as at policy level regarding global change. Remote sensing data has been considered a privileged data source due to its spatial and temporal coverage, and its use successful in global change studies. Although included in global studies, the Iberian Peninsula (IP) is a target region due to its high vulnerability to climate change forcing. The main goals of CARBERIAN are (i) assessment of the intra and inter-annual trends of vegetation carbon balance through ENVISAT MERIS data in the IP, and (ii) exploratory analysis of the influence of the North Atlantic Oscillation (NAO) teleconnection patterns on those vegetation patterns.

Three scientific fields are covered by CARBERIAN:

(1) Biosphere modelling based on MGVI data. The CASA model has been selected, due to its ability to model terrestrial ecosystem production based on satellite data as proved by its wide application. Furthermore, the team has already been applying it successfully to the IP, based on GIMMS NDVI (NASA) datasets, whose results were used for a benchmarking analysis within the ATEAM European project. CASA model implementation implies the inter comparison analysis between MGVI and GIMMS NDVI, and the validation of modelled vegetation properties.
(2) Deriving vegetation biophysical properties from MERIS. CARBERIAN aims to develop algorithms to derive vegetation biophysical properties, namely above ground biomass (AGB), net primary productivity (NPP) and net ecosystem productivity (NEP) from MERIS data. Remote sensing of AGB and NPP relies on regression analysis based on inventory data for different land cover types and on other remotely sensed variables such as FAPAR and LAI. Furthermore, spectral analysis of MERIS dataset to assess NPP will be performed, based on the sensitivity of vegetation spectral response to variations in photosynthetic rate, stomatal resistance and respiration rate, through radiative transfer models and photosynthesis/resistance models.
(3) Assessment of the NAO impact on vegetation properties. Large-scale circulation patterns such as NAO can be responsible for major anomalies of climatic fields such as precipitation, temperature and radiative balance. Thus, one can hypothesize that the vegetation patterns in the IP are associated with NAO teleconnection patterns, through the hydrological cycle variability. Statistical modelling will support the exploratory analysis to identify the NAO response signal presented by the vegetation patterns. This relationship will assist the development of a seasonal forecasting scheme for the vegetation properties.

CARBERIAN has two novel research goals: modelling the carbon cycle biosphere component, using the European MERIS as the major dataset, and establishing a link between the variability of vegetation biophysical parameters and the corresponding variability of large-scale atmospheric circulation modes, such as NAO. Considering the IP as a functional unit of analysis is a major source of innovation, contributing to increase the knowledge of Mediterranean like ecosystems on the global carbon cycle.

2004

Projects related to Climate Change

CLIMATE CHANGE AND TOURISM IN PORTUGAL: POTENTIAL IMPACTS AND ADAPTATION MEASURES (CLITOP)
Fundação da Faculdade de Ciências

BIOARIDRISK – SPACE-TIME EVALUATION OF THE RISKS OF CLIMATE CHANGES BASED ON AN ARIDITY INDEX
Instituto Superior Técnico

CLIMATIC /ENVIRONMENTAL FACTORS AFFECTING THE POPULATION DYNAMICS OF *LYMNAEA TRUNCATULA* AND TRANSMISSION OF *FASCIOLA HEPATICA* IN PORTUGAL.
Instituto de Higiene e Medicina Tropical

PRESENT AND FUTURE PORTUGUESE COASTAL CLIMATE AND ITS IMPACT ON THE BIOLOGICAL COMMUNITIES (PORTCAST)
Fundação da Faculdade de Ciências

CLIMATE CHANGE INFERENCES FROM TREE RINGS IN THE MEDITERRANEAN AREA: A DATABASE FOR PORTUGAL
Instituto do Mar

CIDMEG - CONSTRUCTION OF A DESERTIFICATION SUSCEPTIBILITY INDEX FOR THE LEFT MARGIN OF GUADIANA
Instituto Superior Técnico

LINKING WATER AND CARBON CYCLES IN EUCALYPT PLANTATIONS
Instituto Nacional de Investigação Agrária e das Pescas

ALQUEVA XXII - SHOOTING AT A MOVING TARGET. SCENARIOS OF AGRICULTURAL LAND USE OF THE ALQUEVA IRRIGATION PROJECT IN A CHANGING ENVIRONMENT. CLIMATE CHANGE, CROP OPTIONS AND WATER NEEDS.
Instituto Superior de Agronomia

IMPACT OF CLIMATIC AND ANTHROPIC VARIATIONS ON THE NORTHERN CONTINENTAL SHELF, GULF OF CADIZ
Universidade do Algarve

VULNERABILITY OF CORK OAK WOODLANDS TO CLIMATE CHANGE: A MODELLING APPROACH
Instituto Superior de Agronomia

URBAN FLOOD RISK AND POLLUTANT RELOCATION AS A RESULT OF GLOBAL CHANGE
Escola Superior Agrária de Coimbra

USE OF TRADITIONAL KNOWLEDGE TO ATTAIN WATER SUSTAINABLE MANAGEMENT UNDER DIFFERENT CLIMATE CHANGE SCENARIOS - TRADWATER
Universidade de Aveiro

LATITUDINAL VARIATION ON THE BIOLOGY OF ESTUARINE KEY-SPECIES AS A TOOL TO PREDICT CLIMATE CHANGE EFFECTS
Centro de Investigação Marinha e Ambiental

Other areas of investigation

Agricultural and Forest Sciences – General Investigation

SIMULATION OF THE EFFECT OF DIFFERENT FOREST MANAGEMENT STRATEGIES AND CLIMATE CHANGE ON WOOD/CORK AND CARBON SEQUESTRATION FOR THE MOST IMPORTANT SPECIES OF PORTUGUESE FOREST (CARBWOODCORK)
Instituto Superior de Agronomia

MEDITERRANEAN WOODY SPECIES OF MONTADOS: SURVIVING THE DROUGHT
Instituto Nacional de Investigação Agrária e das Pescas

Communications Science Area

THE POLITICS OF CLIMATE CHANGE: DISCOURSES AND REPRESENTATIONS
Universidade do Minho

Marine Sciences and Technologies Area

STUDYING THE IMPACT OF THE CLIMATE CHANGE IN THE PORTUGUESE COASTAL WATERS - THE AVEIRO COSTAL ECOSYSTEM - SIMCLAVE
Universidade de Aveiro

Funded By other Institutions

Environment Institute (IA)

2004

Title
ALTERAÇÕES CLIMÁTICAS EM PORTUGAL, CENÁRIOS, IMPACTES E MEDIDAS DE ADAPTAÇÃO (SIAM II)

Proposing Institution
Universidade de Lisboa – Fundação da Faculdade de Ciências

Summary

Phase II of the SIAM project, financed by the Portuguese Ministry of Cities, Spatial Planning, and the Environment continued the research started in phase I using updated climate models, with two additional components: an outreach and a case-study component. The former involved a series of outreach sessions held across the country in Beja, Bragança, Covilhã, Ílhavo, Olhão, Peniche and Oporto, in which the impacts of and adaptation measures to climate change upon locally relevant socio-economic sectors were discussed with a total of 125 representatives of government, academia, environmental NGOs, industry, and other representatives of civil society.

The case-study component, focusing predominantly on the Sado Estuary, sought to apply the general methodology of project SIAM (climate scenarios as an input to each sector's impact assessment) at a smaller geographic scale. The intention was to provide responses to decision makers in the public sector, at a scale compatible with decision making processes. The Sado Estuary was chosen as it is a geographic area where several socioeconomic and biophysical factors intersect, thus providing a good test for the methodology at a smaller scale.

Fundação Calouste Gulbenkian

2005

Title
Impact E – Impact of extreme events on health in Portugal: past, present and future.

Proposing Institution
Faculdade de Ciências da Universidade de Lisboa

Summary

A multidisciplinary team composed of researchers from several public national and international institutions in the fields of health, epidemiology, climatology, physics and environmental risk assessment was created to undertake this study. The aim is to provide an integrated study of the impact of meteorological and extreme climate events (cold spells, heat waves and drought) and related elements such as air pollution and forest fires on public health in Portugal. Past correlations and projections of future risks based on climate scenarios until the end of the century will be used.

Acronyms

AA-MOPTC	Environmental Audit of the Ministry of Public Works, Transports and Communications
ABAE	European Blue Flag Association/FEE (Foundation for Environmental Education) Portugal
ACAP	Portuguese Automobile Trade Association
ACP	African, Caribbean and Pacific Countries
ADPA	Association for Environmental Defence and Protection
ANA	Airports of Portugal, S.A.
APs	Public Administrations
ARENA	Regional Energy Agency for the Azores Autonomous Region
ASPEA	Portuguese Association of Environmental Education
BUW	Biodegradable Urban Waste
CAC	Climate Change Commission mater
CDM	Clean Development Mechanism
CGA	*Caixa Geral de Aposentações* (Pensions Fund of Public Servants)
CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COP	Conference of the Parties
CP	*Comboios de Portugal* (National Train Company)
CPLP	Community of Portuguese Speaking Countries
CQ1	Level 1 Quality Control Procedures
CQ2	Level 2 Quality Control Procedures
CRF	Common Reporting Format
CTS/A	Science, Technology, Society and Environment
DAC	Development Assistance Committee
DGGE	Directorate-General for Geology and Energy
DGRF	Directorate-General for Forestry
DGS	Directorate-General for Health
DGTT	Directorate-General for Land and Water Transport
EC	European Commission
ENGO	Environmental Non-Governmental Organisation
ETAR	Wastewater Treatment Plant
EU	European Union
EU-ETS	European Union Emissions Trading Scheme
EURONATURA	Centre for Environmental Law and Sustainable Development
FAPAS	Fund for the Protection of Wildlife
FCT	Science and Technology Foundation
FEADER	European Agricultural Fund for Rural Development
FER	Renewable Energy Sources
FFP	Permanent Forestry Fund
GB	Guinea-Bissau
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEOTA	Research Group on Spatial Planning and the Environment
GHG	Greenhouse Gas(es)
GPG	Good Practice Guide
GVA	Gross Value Added
GWP	Global Warming Potential
hab	Inhabitant
HFC	Hydrofluorocarbon

HIW	Hazardous Industrial Waste
HPI	Hydroelectric Productivity Index
HW	Hospital Waste
I&CLC2000	Image and CORINE Land Cover 2000
IA	Institute for the Environment
IGP	Portuguese Geographic Institute
INE	National Statistics Institute
INERPA	National Inventory of Emissions by Sources and Removals by Sinks of Air Pollutants
INR	National Waste Management Institute
IPAD	Portuguese Institute for Development Support
IPCC	Intergovernmental Panel on Climate Change
IPT	Inter-urban Passenger Transport
ISMS	Integrated IT System for the Management of the SNIERPA
IW	Industrial Waste
KP	Kyoto Protocol
LDC	Least Developed Countries
LDCF	Least Developed Countries Fund
LPN	League for the Protection of Nature
LULUCF	Land Use, Land Use Change and Forestry
MADRP	Ministry of Agriculture, Rural Development and Fisheries (includes Forestry)
MAI	Ministry of Internal Administration
MAOTDR	Ministry of the Environment, Spatial Planning and Regional Development
MCTES	Ministry of Science, Technology and Higher Education
ME	Ministry of Education
MEI	Ministry of Economy and Innovation (includes Energy and Industry)
MFAP	Ministry of Finance and Public Administration
ML	Lisbon Metro
MNE	Ministry of Foreign Affairs
MOP	Meeting of the Parties
MOPTC	Ministry of Public Works, Transports and Communications
MP	Oporto Metro
MSW	Municipal Solid Waste
MW	Municipal Waste
N_2O	Nitrous Oxide
NAPA	National Adaptation Plan of Action
NGO	Non-Governmental Organisation
NIR	National Inventory Report
NMVOC	Non-methanic volatile organic compounds
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
PALOP	(Portuguese Speaking African Countries)
PATO	Association for the Protection of "Paúl da Tornada"
PDM	Methodological Development Programme
PEAASAR	Strategic Plan for Water Supply, Sewerage and Wastewater Treatment 2000–2006
PERSU	Strategic Plan for Urban Solid Waste
PIC	Indicative Co-operation Programmes
pkm	Passengers-kilometers
PLOP	Portuguese Speaking Countries
PNAC	National Climate Change Programme
PNALE	National Allocation Plan
PNDFCI	National Plan for Protection Against Forest Fires
PROFs	Regional Plans for Forestry Planning
QA	Quality Assurance

QUERCUS	National Association for Nature Conservation
RCM	Council of Ministers Resolution
RELAC	Portuguese Speaking Countries Climate Change Network
RIOCC	Iberian-American Climate Change Network
RNAP	National Network of Protected Areas
SB	Subsidiary Bodies to the Convention
SCCF	Special Climate Change Fund
SCGQ	Quality Control and Assurance System
SEA	Secretary of State for the Environment
SGIR	Information Management System on Waste
SGP	Stability and Growth Pact
SIDCLIMAD	Climate and Sea Information System for Sustainable Development
SNBPC	Fire and Civil Protection National Service
SNIERPA	Portuguese National System for the Estimation of Emissions by Sources and Removals by Sinks of Air Pollutants
SoER	State of the Environment Report
SPV	"Sociedade Ponto Verde" (national packaging collection and recycling company)
TAP	Air Portugal (national airline)
tkm	Tonnes-kilometer
toe	Tonnes of oil equivalent
UAA	Utilised Agricultural Area
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Education, Science and Culture Organisation
UNFCCC	United Nations Framework Convention on Climate Change
ZIF (FIZ)	Forestry Intervention Zones

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